Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
Total Program Element	-	26.913	30.659	25.839	-	25.839	27.893	28.168	28.056	25.686	0.000	193.214
CN4: *Network Enabling University Applied Research*	-	2.558	2.675	2.526	-	2.526	2.273	2.274	2.299	2.323	0.000	16.928
CN5: *Network Vuln/ Effectiveness Assess Methods (N-VEAM)*	-	4.320	4.478	4.487	-	4.487	4.493	4.496	4.546	4.591	0.000	31.411
CW2: *Exploitation of Atmospheric Impacts across Domains*	-	2.940	1.514	-	-	-	-	-	-	-	0.000	4.454
CX3: *Intelligent Env Battlefield Awareness Apl Tech*	-	3.026	2.201	1.619	-	1.619	2.098	2.021	1.418	-	0.000	12.383
CX4: *Persistent Geophysical Sensing-Infrasound Apl Tech*	-	2.660	2.576	2.085	-	2.085	3.142	2.619	2.294	2.174	0.000	17.550
CX5: *Sensing in Contested Environments Technologies*	-	0.970	1.028	0.517	-	0.517	1.118	2.082	1.600	1.616	0.000	8.931
CX6: *Subterranean Detection and Monitoring Apl Tech*	-	1.529	1.688	1.536	-	1.536	1.136	0.645	2.224	1.728	0.000	10.486
CZ6: *Assured PNT Enabling Applied Technology*	-	3.527	3.347	2.324	-	2.324	2.276	2.141	2.164	2.186	0.000	17.965
CZ7: *Convergent CEMA Technical Effects*	-	5.383	5.472	5.584	-	5.584	5.591	5.595	5.656	5.712	0.000	38.993
DA8: *Quantum PNT & Radio Frequency Sensing*	-	-	2.612	3.664	-	3.664	5.242	5.246	5.303	5.356	0.000	27.423
DB4: *Enabling Long Standoff 3D (ELS3D) Tech*	-	-	2.058	1.092	-	1.092	0.524	1.049	0.552	-	0.000	5.275
DE6: *Understanding Environment as a Threat Tech*	-	-	1.010	0.405	-	0.405	-	-	-	-	0.000	1.415

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army	Date: March 2024
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602182A *I C3I Applied Research*

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates, designs, validates, and conducts experimentation to establish technical solutions for creating integrated future equipment and systems that improve resiliency, survivability, operational effectiveness, mobility, sustainability, and readiness of ground forces. This PE provides mid-to-long term tactical Command, Control, Communications and Intelligence (C3I) capabilities (e.g., networking, cyber, electronic warfare, Positioning, Navigation and Timing (PNT), space, persistent surveillance) based upon promising technologies that address emerging and future threats and includes research critical and unique to the Army and DoD (e.g., atmospheric modeling and meteorological technologies). Applied research investments focus on the design and investigation of materials, processes, technologies, methodologies, and models to establish architectures, systems, and interfaces that enhance and optimize performance on the future battlefield. The outputs of these efforts inform and transition to advanced research efforts that demonstrate improved C3I capabilities.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	27.868	30.659	23.868	-	23.868
Current President's Budget	26.913	30.659	25.839	-	25.839
Total Adjustments	-0.955	0.000	1.971	-	1.971
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.001	-			
• SBIR/STTR Transfer	-0.954	-			
• Adjustments to Budget Years	-	-	1.971	-	1.971

Change Summary Explanation

Increase funding reflects planned research in high-precision PNT sensors to improve the accuracy and resilience of Army PNT and GPS.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CN4 / *Network Enabling University Applied Research*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CN4: *Network Enabling University Applied Research*	-	2.558	2.675	2.526	-	2.526	2.273	2.274	2.299	2.323	0.000	16.928

A. Mission Description and Budget Item Justification

The Project leverages applied research from academia, in the focus areas of intelligent networks, self-sensing/self-healing networks, network security, air and ground vehicle teaming and alternatives to Global Positioning System (GPS). This Project will focus on research that supports mid-to-long term tactical Command, Control, Communications and Intelligence (C3I) capabilities (e.g. networking, cyber, electronic warfare, Positioning, Navigation and Timing (PNT), space, persistent surveillance). This Project also focuses on bringing competitively selected Universities with research and development teams into Technical Alliances that will investigate and develop technologies originating from applied research in academia pertaining to intelligent networks, self-sensing/self-healing networks, and network security and artificial intelligence/machine (AI/ML) learning as applied to C3I, and other innovative communication as well as alternatives to GPS, leading to potential emerging technologies in areas of strategic importance to the Army in secure and intelligent communication and networking.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CN3 (Network Enabling University Adv Development).

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the University Technology Development Division.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Intelligent, Secure and Self-Sensing/Self-Healing Networks Applied Technology	1.227	1.291	1.344
Description: Investigate and design fused networks and decision-making architecture into intelligent networks to provide the actionable autonomous intelligence while denying corruption, and/or attack and to execute operational missions securely and reliably. ***FY 2024 Plans:*** Will continue to investigate AI/ML emerging technologies for Network solutions, distributed hybrid ML at various scales, adaptable network systems, unified framework for joint sensing, RF-based deceptive tactical networks, improve cyber defense systems through secure and reliable ML, and network localization. ***FY 2025 Plans:*** Will fund research to investigate the next generation artificial intelligence(AI)-trained predictive intelligent network Agent, incorporating continually enhanced field training of Adversarial/Network Traffic agents; fund research to investigate artificial intelligence/machine learning (ML) emerging technologies for Network solutions, distributed hybrid ML at various scales,			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CN4 / *Network Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
adaptable network systems, unified framework for joint sensing, Radio Frequency (RF)-based deceptive tactical networks, and to improve cyber defense systems through secure and reliable ML and network localization to enable a more intelligent and robust communications network. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Real-Time Tactical Networks Applied Research ***Description:*** Investigate and design an intelligent information network that will resiliently support information pathways for sensing, computing, and control in cyber-physical systems, to improve continuity of service. Design a network to adapt and maintain connectivity if critical components become disconnected or fail. ***FY 2024 Plans:*** Design and develop an information network that will resiliently support information pathways for sensing, computing, and control in cyber-physical systems, such as autonomous vehicle teams over unreliable communication networks. Design an information network that responds dynamically to changes in operating conditions through real-time adaptation and evolution to enable continuity of the core services that it provides to the networked system. ***FY 2025 Plans:*** Will investigate and develop a resilient information system that can support pathways to generate information products, including sensor fusion applications, for situational awareness, command and control, communication, and computation degradation, as well as an integration of a variety of sensors and compute capabilities for situational awareness and resource optimization. Research emerging intelligent tactical networks to enable a resilient tactical network with reduced bandwidth requirements. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.	0.585	0.614	0.640
Title: Alternatives to GPS Applied Research ***Description:*** Research emerging technologies for performance and assurance improvements to position, navigation and timing (PNT) both with and without GPS to improve weapons accuracy, manned and unmanned autonomous maneuver, force tracking, and other tactical functions. Investigate emerging alternate PNT technologies through academia that may be applied to dual use or military applications, for increased capability or use in GPS denied environments. ***FY 2024 Plans:***	0.746	0.770	0.542

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CN4 / *Network Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Investigates and designs GNSS global and tactical sensors, exploitation of LEO satellites for jam-resistant PNT extraction, and create a sensor fusion framework that high integrity PNT. ***FY 2025 Plans:*** Will research novel techniques and technologies for position, navigation, and timing (PNT) and alternatives to GPS, including performance and assurance improvements that can provide PNT technology to users in disrupted, degraded or denied GPS environments. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Decrease funding reflect planned lifecycle for this effort			
Accomplishments/Planned Programs Subtotals	2.558	2.675	2.526

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CN5 / *Network Vuln/Effectiveness Assess Methods (N-VEAM)*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CN5: *Network Vuln/ Effectiveness Assess Methods (N-VEAM)*	-	4.320	4.478	4.487	-	4.487	4.493	4.496	4.546	4.591	0.000	31.411

A. Mission Description and Budget Item Justification

This Project develops analytical methodology and capabilities to characterize hardware and software that enable Electromagnetic Warfare (EW) and Cyber capabilities to assess operations of Army Network and communication platforms and dismounts, while maintaining freedom to maneuver, communicate, and sense. This Project also develops a holistic cross-domain analysis and assessment methodology for network and communication technologies faced with advanced Cyber Electromagnetic Activity (CEMA). These investigations are critical to identifying vulnerabilities of United States systems and technologies so that network and network-enabled systems can be hardened as early in development as possible.

Work in this Project complements Program Element (PE) 0602146 (Network C3I Technology) / Project AN3 (Non- Traditional Waveforms Technology), PE 0602213 (C3I Applied Cyber) / Project 2CY (Information Trust Technology), PE 0602213 (C3I Applied Cyber) / Project CY6 (Autonomous Cyber Technology), PE, 0602146 (Network C3I Technology) / Project CI3 (Mobile and Survivable Command Post (MASCP) Tech), PE 0603457 (C3I Cyber Advanced Development) / Project 8CY (Information Trust Advanced Technology), PE 0603463 (Network C3I Advanced Technology) / Project AN4 (Non-Traditional Waveforms Advanced Technology), PE 0603457 (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology), PE 0603463 (Network C3I Advanced Technology) / Project AM7 (Modular RF Communications Advanced Technology), and PE 0603463 (Network C3I Advanced Technology) / Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by Combat Capabilities Development Command (DEVCOM) Analysis Center (DAC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Understanding, Protecting, and Enabling CEMA Effects	2.183	2.241	2.256
Description: This effort develops and continually improves methodology and approaches for estimating and predicting CEMA effects on networks and network-enabled systems during complex multi-domain operations when significant cross-domain effects can be expected. Methods include drawing upon past research concerning the interaction of cyber and Electromagnetic Warfare threats on operational networks; laboratory operations, over-the-air anechoic chamber experimentation, and open-air field experimentation; and first principles Modeling and Simulation (M&S) and engineering analysis. Abstracting, generalizing, and automating multi-domain CEMA operations will enable the development of analysis and assessment of capabilities to anticipate			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CN5 / *Network Vuln/Effectiveness Assess Methods (N-VEAM)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
the impact of future threats. Live, virtual, and simulated environments will be developed to estimate the potential operational impact of threat CEMA technologies on friendly systems. ***FY 2024 Plans:*** Will conduct research to assess network technologies using EW and Cyber effects at the component and system level designated for Capability Set 25 and investigate EW and Cyber techniques for converged assessment of EW and Cyber effects on network system at the component level in support of Capability Set 27 (Automation and intelligence for next generation, secure communications and network data transport) ***FY 2025 Plans:*** Will mature and validate the performance of analytic tools and methodologies for the assessment of emerging network technologies using EW and Cyber effects on network systems at the system and component level; investigate analytic techniques for EW and Cyber effects on Integrated Tactical Network technologies; research early developmental network technologies to gain knowledge and understanding of advanced tools and methodologies. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Vulnerability Analysis Methodology for CEMA Threats ***Description:*** This effort investigates threat/target interactions to develop experimental and analytical methodology for separate and cross-domain cyber and electromagnetic threat attack so that assessed vulnerabilities in a multi-domain complex environment can be reduced or eliminated before fielding new networks and network-enabled systems. Experimental and analysis methodologies will be developed to investigate vulnerabilities of specific configurations of complex future networks with multiple communications modalities, advanced deception techniques in the cyber and electromagnetic areas, and advanced Positioning, Navigation, and Timing (PNT) systems. ***FY 2024 Plans:*** Will develop assessment methodologies, tools, and metrics (e.g. LPD/LPI Angle of Arrival, UV line-of-sight (LOS)/beyond-line-of-sight (BLOS), inertial aided PNT) for evaluation of UV and millimeter-Wave dispersed communications in threat representative contested/congested environments; investigate and exploit Cyber vulnerabilities of Artificial Intelligence (AI)/Machine Learning (M/L) based intrusion detection systems (IDS); conduct research to develop and mature contested/congested Cyber and electromagnetic environment threat representation capabilities (e.g. adversary signal detection and identification); conduct research on emerging cloud and Elastic Compute Cloud through creation of use cases to mature methodologies and tools for evaluation of tactical and enterprise systems. ***FY 2025 Plans:***	2.137	2.237	2.231

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CN5 / *Network Vuln/Effectiveness Assess Methods (N-VEAM)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will conduct experiments to mature and validate assessment tools, and methodologies (e.g. Low Probability of Detection/ Low Probability of Intercept (LPD/LPI) Angle of Arrival, optical communications, assured PNT, testbeds) for network systems performance in threat representative congested and contested environments; develop metrics that are repeatable and can be used to accurately quantify and assess Integrated Tactical Network technologies and communication systems; conduct research to determine and develop emerging Cyber and electromagnetic environment threat representation capabilities; conduct research on emerging threats required for assessing future Army capabilities. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	4.320	4.478	4.487

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army												Date: March 2024
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*				Project (Number/Name) CW2 / *Exploitation of Atmospheric Impacts across Domains*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
CW2: *Exploitation of Atmospheric Impacts across Domains*	-	2.940	1.514	-	-	-	-	-	-	-	0.000	4.454

Note

In Fiscal Year (FY) 2025, this Project is restructured to PE 0602144A (Ground Technology)/ Project DI7 (Environmental Security Resilience Technology).

A. Mission Description and Budget Item Justification

This Project enables identification and exploitation of how atmospheric phenomena impact windows of superiority for Army capabilities by developing technologies that characterize, predict, and efficiently express atmospheric impacts in future operating environments. New sensing technologies and algorithms enable heterogeneous sensor networks to extract critical environmental information optimizing performance and reducing the need for dedicated meteorological sensors. Novel physics-based models, empirical parameterizations, and machine learning applications extrapolate this environmental information both spatially and temporally. Uncertainty-aware decision support tools leverage this situational awareness to efficiently express atmospheric effects on friendly and threat weapons systems, sensors, and operations at the point of need and across multiple domains. This information can be exploited by autonomous and human decision makers for mission planning and execution; battlefield visualization; reconnaissance, surveillance, and target acquisition; route planning to maximize stealth and efficiency; long-range precision fires; and modeling of environmental impacts for combat simulations and war games.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Atmospheric Impacts	2.940	1.514	-
Description: This effort develops environmental exploitation capabilities though coupled sensing, numerical prediction, and decision support technologies for data-sparse, computationally-limited, and network-constrained domains.			
FY 2024 Plans: Will conclude the combination of multi-modal small Unmanned Aerial Systems (sUAS) detection, classification, and localization sensing capabilities; finalize and transition capabilities for rapid optical characterization of hazardous, biological, and non-biological aerosols.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CW2 / *Exploitation of Atmospheric Impacts across Domains*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned life cycle conclusion of this Science and Technology effort.			
Accomplishments/Planned Programs Subtotals	2.940	1.514	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CX3 / *Intelligent Env Battlefield Awareness Apl Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CX3: *Intelligent Env Battlefield Awareness Apl Tech*	-	3.026	2.201	1.619	-	1.619	2.098	2.021	1.418	-	0.000	12.383

Note

In Fiscal Year (FY) 2025, CX3 /Hydrology Mapping and Vegetation Property Mapping Technology Funding will transition to Program Element 0603042A (C3I Advanced Technology and) / Project CX7 (Intelligent Environment Battlefield Awareness Advanced Technology).

A. Mission Description and Budget Item Justification

This Project investigates, develops, and designs technologies to allow Soldiers to maneuver faster in dynamic environments as informed by physical, geological, and biological constraints. This Project enhances visualization tools for mission planning through delivering web modules/software tools which contain crucial geochemical resources and advanced knowledge of geo-environmental infrastructure for mission planners. These technologies provide situational awareness for multi-source intelligence, particularly in anti-access/area denied (A2/AD) operational environments.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology (Adv Tech)) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed at the United States Army Engineer Research and Development Center Environmental Laboratory, Geospatial Research Laboratory, Information Technology Laboratory, Cold Regions Research and Engineering Laboratory, Construction Research Engineering Laboratory, and Geotechnical and Structures Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Hydrology Mapping	0.991	0.679	-
Description: This effort provides data tools and models to support high-fidelity battlefield overlay maps that accurately show hydrologic/soil moisture threats (soil, hydrology, and snow/ice) not captured by current terrain mapping capabilities.			
FY 2024 Plans: Will develop Machine Learning (ML) methodologies to derive parameters for a stochastically based hydrologic model using high-resolution hydrologic and remotely sensed data.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CX3 / *Intelligent Env Battlefield Awareness Apl Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned conclusion of this effort and transition to Program Element 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).			
Title: Predictive Geographic Information System (GIS) Mapping (physical) ***Description:*** This effort develops a comprehensive GIS tool that integrates predictive models of soil, vegetation, hydrology, and permafrost conditions in Outside Continental United States (OCONUS) dark sites from the statistical analysis of known datasets and the application of geophysical principles. ***FY 2024 Plans:*** Will complete development of foundational data layers in a comprehensive GIS tool that integrates predictive models of soil, vegetation, hydrology, and permafrost conditions. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned conclusion of this effort and transition to Program Element 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).	1.255	1.010	-
Title: Vegetation Property Mapping Tech ***Description:*** This effort investigates and develops the required data to build geospatial overlays that describe forest type and structure as it relates to maneuver and concealment. ***FY 2024 Plans:*** Will characterize non-forested (single-strata) vegetation attributes at multiple vegetation analog sites relevant for open terrain mobility and proxies in threat area terrain attributes. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned conclusion of this effort and transition to Program Element 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).	0.199	0.261	-
Title: Extreme Environments Environmental Effects on Operations Tech ***Description:*** This effort designs and develops modeling of natural terrain following extreme disturbances that impact operational environments such as wildfires, flash floods, earthquakes and landscape changes induced by high intensity military conflict. ***FY 2024 Plans:*** Will investigate existing data algorithms ability to predict extreme events and will identify which events cause anomalies in model accuracy. ***FY 2025 Plans:***	0.581	0.251	0.617

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CX3 / *Intelligent Env Battlefield Awareness Apl Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will develop and deploy training data sets for machine learning algorithms for extreme event post disturbance detection. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects the planned milestones for development of machine learning based tools.			
Title: Terrestrial Ice Operations ***Description:*** This effort will design and develop a capability to effectively utilize frozen inland water bodies, specifically located in complex Arctic and sub-Arctic environments, in the projection of forces and materials in support of homeland defense, humanitarian assistance and disaster relief. The incorporation of wide area to localized remote sensing assets for the determination of ice thickness, continuity, and strength will inform the development of tactical scale geospatial overlays. Data maturation and algorithm refinement will result in a near real time level-of-risk assessment for the safe and effective performance of on ice operations. ***FY 2025 Plans:*** Will investigate primary variables needed for the determination of ice thickness, continuity, and strength. Will investigate applicable stand-off technologies to assist with desktop ice characterization, and the ice properties that control quality of the stand-off acquisitions. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort.	-	-	1.002
Accomplishments/Planned Programs Subtotals	3.026	2.201	1.619

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CX4 / *Persistent Geophysical Sensing-Infrasound Apl Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CX4: *Persistent Geophysical Sensing-Infrasound Apl Tech*	-	2.660	2.576	2.085	-	2.085	3.142	2.619	2.294	2.174	0.000	17.550

A. Mission Description and Budget Item Justification

This Project designs and develops algorithms, hardware, and software components to provide passive, persistent, non-line-of-sight, multi-modal sensing capable of providing fused battlefield intelligence for increased situational awareness in a dynamic operational environment. These technologies provide near-real-time data collection, processing, and alerting on evolving cross-domain threats including strategic and tactical fires, air and ground platforms, as well as critical transportation infrastructure (bridges) and explosive events with applications for deep sensing.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX8 (Persistent Geophysical Sensing-Infrasound Adv Tech).

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work is performed by the United States Army Engineer Research and Development Center Geotechnical and Structures Laboratory, Coastal and Hydraulics Laboratory, Construction Engineering Research Laboratory, Cold Regions Research and Engineering Laboratory, Environmental Laboratory, and Information Technology Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Battlefield Intelligence by Geophysical Sensing (BIGS)	2.660	2.576	-
Description: This effort develops a suite of geophysical and geo-sensing technologies to persistently assess battlefield elements to include infrastructure and additional sources of interest such as explosive and fires events and various air platforms; refines terrain, topography, and meteorological models related to acoustic propagation detected by the employed sensor suite as well as detection and classification signal processing algorithms for a broader range of sources and/or threats. Technologies provide Commander's situational awareness for multi-modal intelligence, particularly in anti-access/area denied (A2/AD) operational environments.			
FY 2024 Plans: Will mature algorithm components utilizing multiple laboratory and field experiments in conjunction with various array configurations and will design and develop a sensor placement tool with capabilities to account for terrain/topography and meteorological effects.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CX4 / *Persistent Geophysical Sensing-Infrasound Apl Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned conclusion of this effort and transition to Program Element 0603042A (C3I Advanced Technology) / Project CX8 (Persistent Geophysical Sensing-Infrasound Adv Tech).			
Title: Multi-Domain Operations for Adaptable Wide Area Reconnaissance (MDO AWARe) ***Description:*** This effort develops an easily emplaced, rapidly deployable, multi-modal geophysical tactical array for persistent, wide area, remote, non-line-of-sight monitoring for potential deep sensing to extend monitoring ranges and investigate new processing techniques to allow for the battlespace awareness needed in Multi-Domain Operations in both Competition and Armed Conflict phases. ***FY 2025 Plans:*** Will investigate edge computing methods and hardware applicability to tactical deployments while maintaining ability to detect, classify, and localize sources of interest such as explosive and fires events and various air platforms. Will design fielding support tools for the geophysical tactical array to enable optimized employment. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort.	-	-	2.085
Accomplishments/Planned Programs Subtotals	2.660	2.576	2.085

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CX5 / *Sensing in Contested Environments Technologies*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CX5: *Sensing in Contested Environments Technologies*	-	0.970	1.028	0.517	-	0.517	1.118	2.082	1.600	1.616	0.000	8.931

A. Mission Description and Budget Item Justification

This Project characterizes through direct or inferential methods the identification of non-weaponized biological hazards posed to Soldiers in operational environments by advancing sensor technologies and software modules that will detect and characterize hazards within confined environments. This research provides Soldiers the capability to understand biological hazards present in subterranean environments and take necessary steps to mitigate or avoid these threats.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX9 (Sensing in Contested Environments Advanced (Adv) Technologies).

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed at the United States Army Engineer Research and Development Center Environmental Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Non-traditional Threat Detection in Contested Environments Tech	0.970	1.028	0.517
Description: This effort identifies, examines and prioritizes previously developed sensor packages as well as commercial of the shelf (COTS) capabilities from multiple sources that can accurately detect biological hazards relevant to operations in subterranean environments from point of ingress/egress to evaluate exposure potential and effects. ***FY 2024 Plans:*** Will develop alternative zoonotic assays and antibody/antigen methods; and will assess potential sample techniques for standoff collection and select most appropriate for modification. ***FY 2025 Plans:*** Will determine the ability of trained users to successfully complete microbiological analyses using selected sensor packages and developed protocols that accurately detect biological hazards. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned conclusion of this effort and transition to PE 0603042A (C3I Advanced Technology) / Project CX9 (Sensing in Contested Environments Adv Technologies).			
Accomplishments/Planned Programs Subtotals	0.970	1.028	0.517

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CX5 / *Sensing in Contested Environments Technologies*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CX6 / *Subterranean Detection and Monitoring Apl Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CX6: *Subterranean Detection and Monitoring Apl Tech*	-	1.529	1.688	1.536	-	1.536	1.136	0.645	2.224	1.728	0.000	10.486

A. Mission Description and Budget Item Justification

This Project designs and develops an integrated suite of tunnel detection, subterranean monitoring solutions, and vulnerability assessment technologies to detect, identify, and monitor subterranean threat activities in urban environments through advanced sensing and rapid analysis capabilities. This Project also develops and investigates enhanced technologies to detect tunnels and tunneling activity in complex and varied environments. This research is critical to provide greater situational awareness of the subterranean domain and enhanced survivability for the Soldier.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CZ5 (Subterranean Detection and Monitoring Adv Tech).

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Engineer Research and Development Center Geotechnical and Structures Laboratory, Construction Engineering Research Laboratory, Coastal and Hydraulics Laboratory and Cold Regions Research and Engineering Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Cavity Assessment in Variable Environments-Subterranean (CAVES)	1.529	1.688	1.536
Description: This effort will extend current tunnel detection and perimeter security systems beyond austere environments for application in variable terrain, and complex geologic environments, such as mountains, and hard rock geology common in the western pacific.			
FY 2024 Plans: Will conduct hardware assessment of tunnel detection and perimeter security technologies proven feasible in variable and complex geologic environments, such as mountains, and hard rock geology common in the United States Pacific Command area of responsibility.			
FY 2025 Plans: Will mature selected hardware components and detection algorithms of subsystem components for subterranean detection in hard rock.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CX6 / *Subterranean Detection and Monitoring Apl Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects the planned reduction of workflows as technologies transition to Program Element 0603042A (C3I Advanced Technology) / Project CZ5 (Subterranean Detection and Monitoring Adv Tech).			
Accomplishments/Planned Programs Subtotals	1.529	1.688	1.536

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) CZ6 / *Assured PNT Enabling Applied Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CZ6: *Assured PNT Enabling Applied Technology*	-	3.527	3.347	2.324	-	2.324	2.276	2.141	2.164	2.186	0.000	17.965

A. Mission Description and Budget Item Justification

Assured Positioning Navigation and Timing (APNT) Enabling Technologies project investigates and develops technologies for Space-enabled, Deep Sensing, Counter Surveillance and Reconnaissance (C-SR) and High Altitude applications for Army tactical ground forces. Focus areas include but are not limited to modeling and simulation for C-SR and Deep Sensing technologies, investigate the utilization of space data for Army tactical applications, and developing actionable PNT situational awareness information.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech).

The research cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Space and Missile Defense Technical Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Assured PNT Enabling Applied Technology	3.527	3.347	2.324
Description: This effort supports development of hardware and software components, models and simulations to further Space-enabled, HA, C-SR and Deep Sensing capabilities. ***FY 2024 Plans:*** Will continue to develop, and validate an advanced laboratory testbed that will be utilized to mature payloads for APNT, ground launched assets and optical/quantum secure communications on multiple simulated platforms simultaneously with hardware and software in the loop. Testbed will be applicable for Quantum Entanglement (QE) and HA applications. ***FY 2025 Plans:*** Will mature initial Global Positioning System (GPS) Interference database efforts that will support actionable PNT situational awareness information. Investigate innovative techniques to utilize space-based data for Army Applications. Will conduct modeling and simulation for C-SR, Navigation Warfare, and Deep Sensing applications. ***FY 2024 to FY 2025 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CZ6 / *Assured PNT Enabling Applied Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects funds realigned from High Altitude (HA) payload work to C-SR.			
Accomplishments/Planned Programs Subtotals	3.527	3.347	2.324

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*				Project (Number/Name) CZ7 / *Convergent CEMA Technical Effects*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
CZ7: *Convergent CEMA Technical Effects*	-	5.383	5.472	5.584	-	5.584	5.591	5.595	5.656	5.712	0.000	38.993

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops hardware and software to enable cyber and radio frequency (RF) technical effects along with inconspicuous Cyber Electromagnetic Activity (CEMA) and network operations of Army platforms and dismounts, while maintaining freedom to maneuver, communicate, and sense. This research will investigate and develop methods to protect blue platforms from adversarial detection and attack. This research is critical to counter near-peer adversary ability to geo-locate and put indirect fires onto blue force positions.

Work in this Project complements Program Element (PE) 0602146A (Network C3I Technology) / Project AM6 (Non Modular RF Communications Technology) and Project AN3 (Non Traditional Waveforms Technology), Program Element (PE) 0602213A (C3I Applied Cyber) / Project CI6 (Network Obscuration and Deception Tech) and Project CY6 (Autonomous Cyber Technology), Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology), and Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM7 (Modular RF Communications Advanced Technology) and Project AN4 (Non Traditional Waveforms Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: RF-Enabled CEMA Sensing and Technical Effects	3.168	3.335	3.457
Description: This effort develops technologies to avoid geolocation of blue force RF emissions by peer/near- peer adversaries. Research will focus on developing low probability of detection (LPD) communications and RF transceivers to increase freedom of maneuver while maintaining effective communications.			
FY 2024 Plans: Will validate RF emulator techniques in relevant outdoor environment; investigate antenna architecture to enhance performance in accordance with RF emulator requirements; validate effectiveness of converged cyber and RF emulation effects in relevant environment; validate performance of non-RF integrated breadboard communication demonstrator.			
FY 2025 Plans: Will develop antenna architecture to include higher frequencies by integrating pixel antenna into base wideband antenna; investigate reconfigurable wideband power dividers that can be integrated into wideband antenna; validate advanced RF emulator techniques in operationally realistic environments; investigate antenna integration to enhance performance in accordance with			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CZ7 / *Convergent CEMA Technical Effects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
RF emulator requirements; validate effectiveness of converged cyber and RF emulation and proximal access techniques; validate performance of non-RF integrated breadboard communication demonstrator and alternate communication pathways. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Convergent Networking and CEMA Effects ***Description:*** This effort investigates techniques and develops methods for combining the physical (Radio Frequency) and network (cyber) layers for enhanced effects when coupled with electromagnetic technical effects. Research also investigates methods of adaptive networking using unconventional communication channels and active tactical cyber defense methods to anticipate adversarial activities and effective responses. ***FY 2024 Plans:*** Will investigate radio-frequency low-probability-of-detection techniques and network-level metrics for hybrid coding and diversity approaches to covert communications; develop protocols for and conduct experiments on hybrid radio-frequency/ultraviolet communications networks; develop methods that build asymmetric advantages for defenders over intelligent, near-peer adversaries, to deal with dynamic environments and fast changing mission context that results in uncertainties and partial information; continue to build attack graphs to understand the interdependencies among all known target vulnerabilities and analyze attacker's potential courses of action; develop an architecture of a cyber misrepresentation decision making system in a tactical environment that incorporates graph-based friendly network representation and game theory approaches. ***FY 2025 Plans:*** Will investigate techniques for low probability of detection in partial and uncertain information/defense scenarios based on adversary understanding; integrate cyber misrepresentation decision-making system suitable for the tactical environment, including monitoring and redirection network agents, dynamic honeynet infrastructure, and rapid/automatic content customization encompassing the RF spectrum; investigate the relation between dynamic games and normal games on randomly determined attack graphs to leverage reinforcement learning for deceptive strategies and artificial intelligence (AI)-enabled cyber deception. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned lifecycle of this effort.	2.215	2.137	2.127
Accomplishments/Planned Programs Subtotals	5.383	5.472	5.584

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** CZ7 / *Convergent CEMA Technical Effects*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) DA8 / *Quantum PNT & Radio Frequency Sensing*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
DA8: *Quantum PNT & Radio Frequency Sensing*	-	-	2.612	3.664	-	3.664	5.242	5.246	5.303	5.356	0.000	27.423

A. Mission Description and Budget Item Justification

This project will investigate quantum sensing approaches for positioning, navigation, timing (PNT), and field sensing. The focus is improving the accuracy and resilience of both Army PNT capabilities independent of Global Positioning System (GPS) and situational awareness, including awareness of electromagnetic signals across the entire frequency spectrum. The payoff of this work will be the development of sensing capabilities and approaches that are beyond classical limits enabling a new paradigm of systems that are more secure, resilient, and precise.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Modular GPS Independent Sensors Advanced Tech) and Program Element (PE) 0602146A (Network C3I Technology) / Project AW5 (Modular GPS Independent Sensors Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Quantum-Enhanced Sensing and PNT	-	2.612	3.664
Description: This effort will investigate quantum sensors based on atoms and atom-like color centers in solid state hosts for use as clocks and electromagnetic field sensors. Reducing the size, weight, and power (SWAP) is a primary objective as most quantum devices are still large laboratory-grade experiments. This work will investigate paths to transportable quantum devices that can be tested outside of lab environments and still maintain their high-accuracy performance. The benefits of this effort are more compact quantum sensing components that can be further integrated into systems while preserving quantum enhancements.			
FY 2024 Plans: Will model, design, and assess solid-state sensors for low-size, weight, and power (SWaP) magnetometry and PNT sensing applications; model, design, and develop Rydberg electric field sensors for comparison with conventional receiver antennas.			
FY 2025 Plans: Will develop and mature sensor architectures based on solid-state defects; investigate trade-offs between nitrogen vacancies (NV) in diamond and silicon vacancies, within silicon carbide (SiC), for sensing characteristics; model and design ruggedized			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** DA8 / *Quantum PNT & Radio Frequency Sensing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
magnetometry and high-precision PNT sensors; develop fiber-coupled Rydberg electric field sensor head for future assessment; build portable Rydberg electronics capability for future assessment. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned research milestones in the area of sensor architectures and high-precision PNT sensors.			
Accomplishments/Planned Programs Subtotals	-	2.612	3.664

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) DB4 / *Enabling Long Standoff 3D (ELS3D) Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
DB4: *Enabling Long Standoff 3D (ELS3D) Tech*	-	-	2.058	1.092	-	1.092	0.524	1.049	0.552	-	0.000	5.275

A. Mission Description and Budget Item Justification

This Project investigates and develops a low size, weight, and power (SWAP) laser transmitter, processing algorithms and calibration models tailored for higher resolution 3D data collections over larger areas from longer stand-off for mapping, Intelligence Surveillance and Reconnaissance (ISR) and targeting. Long standoff airborne collection of high-resolution quick turnaround 3D data is vital for mission planning, target detection and identification, fire control, autonomous navigation, kinetic targeting, and battle damage assessment. Existing light detection and ranging (LIDAR) systems are limited to short standoff and/or near-nadir collection, limiting their use against near-peer adversaries and restricting the provision of 3D data. The payoff will enable long standoff airborne collection of high-resolution quick turnaround 3D data through the development LIDAR subsystems and processing algorithms.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project DB5 (Enabling Long Standoff 3D Adv Tech).

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Engineer Research and Development Center Geospatial Research Laboratory, and Geotechnical and Structures Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Signal Processing for Forward Looking Mapping Systems	-	2.058	1.092
Description: This effort will design and develop hardware and software to enable long standoff airborne collection of high-resolution quick turnaround 3-Dimensional Data to provide advanced Geospatial Engineering capabilities that generate timely, more accurate, mission relevant digital information and sharable knowledge products across the Army Common Operating Environment.			
FY 2024 Plans: Will investigate advanced signal processing and calibration models for new configurations for high quality 3D data coverage for standoff airborne collection.			
FY 2025 Plans: Will validate advanced signal processing algorithms and calibration models tailored for higher resolution 3D data collections over larger areas from longer stand-off for mapping, ISR and targeting.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** DB4 / *Enabling Long Standoff 3D (ELS3D) Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned conclusion of this effort and transition to Program Element 0603042A (C3I Advanced Technology)/Project DB5 (Enabling Long Standoff 3D (ELS3D) Adv Tech).			
Accomplishments/Planned Programs Subtotals	-	2.058	1.092

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / *C3I Applied Research*	Project (Number/Name) DE6 / *Understanding Environment as a Threat Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
DE6: *Understanding Environment as a Threat Tech*	-	-	1.010	0.405	-	0.405	-	-	-	-	0.000	1.415

A. Mission Description and Budget Item Justification

This Project designs and advances mission planning software enabling the Soldier to identify, track, and plan for industrial or commercial chemical/environmental threats. Software modules will increase capability of mission based planning technologies providing new operational routing options for mission execution with environmental threat overlays.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project DE7 (Understanding the Environment as a Threat Adv Tech).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.
Work in this Project is performed by the United States Army Engineer Research and Development Center Environmental Laboratory, Geospatial Research Laboratory, and Information Technology Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Subsurface Forensics	-	1.010	0.405
Description: This effort will prepare Soldiers for the risks of deliberate or accidental release of toxic industrial chemicals and materials by investigating and developing methods to collect data to characterize and predict the fate and transport of hazards of concern. ***FY 2024 Plans:*** Will develop new techniques to achieve ultra-low detection levels of explosive constituents, non-weaponized hazards for reverse point sourcing threats increasingly wet, protein rich environments. ***FY 2025 Plans:*** Will validate techniques for ultra-low detection levels of explosive constituents, non-weaponized hazards for reverse-point sourcing threats in dense urban and subterranean environments. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned conclusion of this effort and transition to Program Element 0603042A (C3I Advanced Technology) / Project DE7 (Understanding the Environment as a Threat Adv Tech).			
Accomplishments/Planned Programs Subtotals	-	1.010	0.405

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602182A / *C3I Applied Research*	**Project (Number/Name)** DE6 / *Understanding Environment as a Threat Tech*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A