Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army											Date: April 2022	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
Total Program Element	-	196.055	280.490	32.546	-	32.546	33.403	39.922	40.631	46.023	0.000	669.070
BK8: *Robotics for Engineer Operations Adv Tech*	-	4.194	6.221	6.314	-	6.314	3.784	4.523	6.500	8.179	0.000	39.715
BK9: *Ground System Fluids and Fuels Adv Tech*	-	1.684	1.732	2.301	-	2.301	2.752	3.063	3.150	3.099	0.000	17.781
BL3: *Explosives Forensics Advanced Technology*	-	2.002	2.096	2.214	-	2.214	2.246	2.267	2.267	2.267	0.000	15.359
BL6: *Expedient Passive Protection Advanced Technology*	-	3.051	0.494	3.613	-	3.613	5.998	5.821	4.154	4.773	0.000	27.904
BL8: *Power Projection in A2AD Environments Adv Tech*	-	1.220	2.970	4.948	-	4.948	3.302	4.101	2.660	3.699	0.000	22.900
BM1: *Protection from Advanced Weapon Effects Adv Tech*	-	2.104	5.868	4.856	-	4.856	4.915	5.103	5.302	5.490	0.000	33.638
BO3: *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*	-	181.800	257.100	-	-	-	-	-	-	-	0.000	438.900
CJ9: *Ground Enabling University Adv Development*	-	-	4.009	3.896	-	3.896	4.195	6.002	6.097	6.095	0.000	30.294
CV5: *Engineer Enablers Maneuver, LOG, & Sustainment Adv*	-	-	-	2.539	-	2.539	3.298	4.781	2.183	3.586	0.000	16.387
DA2: *SAFR Alternatives for Readiness Advanced Tech*	-	-	-	1.865	-	1.865	2.913	4.261	5.199	5.509	0.000	19.747
DB8: *Center for Mobile Power and Energy Adv Research**	-	-	-	-	-	-	-	-	3.119	3.326	0.000	6.445

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

Note

Project CV5 (Engineer Enablers Maneuver, LOG, & Sustainment Adv) and Project DA2 (SAFR Alternatives for Readiness Advanced Tech) are New Starts in Fiscal Year 2023 (FY23).

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*

A. Mission Description and Budget Item Justification

This Program Element (PE) matures and demonstrates ground movement and maneuver technologies that support and enable the Army's modernization priority for the Next Generation of Combat Vehicles. This PE also matures, integrates and demonstrates advanced technologies that are necessary and foundational for legacy and future ground platforms and ground maneuver. These technology areas include: robotic and autonomous Army Combat Engineer equipment, liquid logistics (i.e., fuels, lubricants, and oils) and related monitoring and distribution, forensic analysis of explosives and other chemical materials, rapidly deployable passive protection technologies, entry and maneuver assessment technologies and structural hardening technologies to protect personnel and critical assets from advanced weapon effects.

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

Research is performed by the United States (U.S.) Army Futures Command and the U.S. Army Engineer Research and Development Center.

Research in this PE complements PE 0602144A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology), and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	196.055	23.403	0.000	-	0.000
Current President's Budget	196.055	280.490	32.546	-	32.546
Total Adjustments	0.000	257.087	32.546	-	32.546
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	257.100			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	32.546	-	32.546
• FFRDC Transfer	-	-0.013	-	-	-

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: BO3: *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*		
Congressional Add: *Electrical System Safety and Reliability*	5.000	5.000
Congressional Add: *Cold Regions Research*	2.000	2.000
Congressional Add: *High-Performance Concrete Technology*	6.000	6.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603119A *I Ground Advanced Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Secure Management of Energy Generation and Storage*	5.000	5.000
Congressional Add: *Composite Flywheel Technology*	7.000	7.000
Congressional Add: *Robotic Construction Equipment*	5.000	-
Congressional Add: *Environmental Sensors for Explosives*	3.000	-
Congressional Add: *Robotic 4-D Printing of Geopolymer-Based Composites*	2.000	-
Congressional Add: *Materials and Manufacturing Technology for Cold Environments*	4.000	4.000
Congressional Add: *Research Facility Modernization*	6.000	-
Congressional Add: *Program Increase - Smart Installation and Community Program*	5.000	-
Congressional Add: *Program Increase - Flow Battery Demonstration*	20.000	-
Congressional Add: *Program Increase - Corrosion Protection and Prevention*	10.000	-
Congressional Add: *Program Increase - Rapid Entry and Sustainment for the Arctic*	8.000	8.000
Congressional Add: *Program Increase - Secure Management of Energy Generation and Storage*	5.000	-
Congressional Add: *Program Increase - Water Quality and Resiliency*	5.000	5.000
Congressional Add: *Program Increase - Rare Earth Element Extraction*	5.000	-
Congressional Add: *Program Increase - Organic Light Emitting Diode*	5.000	5.000
Congressional Add: *Program Increase - Coatings Technology*	5.000	-
Congressional Add: *Program increase - Heavy Load Simulator*	4.200	-
Congressional Add: *Program Increase - Integrated Microgrids*	4.000	-
Congressional Add: *Program Increase - Infrastructure Resilience and Flood Assessment*	3.000	3.500
Congressional Add: *Program Increase - Single Connection Quick Oil Change System*	3.000	-
Congressional Add: *Program Increase - Clean Modular Hydro Technology*	4.000	8.000
Congressional Add: *Program Increase - Accelerator Technology for Ground Maneuver*	5.000	5.000
Congressional Add: *Program increase - Autonomous Combat Engineering Solutions*	5.500	4.000
Congressional Add: *Program Increase - Coastal Terrain Hazard Research*	8.000	6.000
Congressional Add: *Program Increase - Expeditionary Deployment of Fully Sustainable Utility*	10.000	-
Congressional Add: *Program Increase - Graphene Research*	5.000	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603119A *I Ground Advanced Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Program Increase - Impacts of Soil Structures on Hydrology*	4.000	5.000
Congressional Add: *Program Increase - Operational Energy Research*	1.300	-
Congressional Add: *Program Increase - Temperature Insensitive High?Energy Density Lithium?Ion Batteries*	2.500	-
Congressional Add: *Program Increase - Vehicle Performance Reliability and Operations*	3.000	-
Congressional Add: *Program Increase - Cross-Laminated Timber and Recycled Carbon Fiber Materials*	1.300	5.500
Congressional Add: *Program Increase - Advanced Explosion Resistant Window Systems*	5.000	-
Congressional Add: *3D Printing of Concrete*	-	2.000
Congressional Add: *3D Printing of Infrastructure*	-	5.000
Congressional Add: *Additive Construction for Field Deployment*	-	4.000
Congressional Add: *Anticipating Threats to Natural Systems*	-	5.000
Congressional Add: *Army Visual and Tactical Arctic Reconnaissance*	-	2.000
Congressional Add: *Assessments and Monitoring Systems for Historic Structures*	-	5.000
Congressional Add: *Autonomous Construction and Manufacturing*	-	5.000
Congressional Add: *Biofuel*	-	6.000
Congressional Add: *Biomass Polymer Technology*	-	2.000
Congressional Add: *Cold Weather Energy Research*	-	5.000
Congressional Add: *Cold Weather Research*	-	3.000
Congressional Add: *Distributed Technologies for Steam Loop Replacements*	-	5.000
Congressional Add: *Electrochemical Conversion of Water Streams*	-	5.000
Congressional Add: *Entry Control Points at Installations*	-	5.000
Congressional Add: *Expeditionary Additive Construction*	-	15.000
Congressional Add: *Explosive Materials Detection*	-	3.000
Congressional Add: *Frost Heave Effects Monitoring*	-	4.500
Congressional Add: *Graphene Applications for Military Engineering*	-	10.000
Congressional Add: *Hardened Facility Standards*	-	4.600
Congressional Add: *High Power Fast Charging for Electric Vehicle Fleets*	-	3.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603119A *I Ground Advanced Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Infrastructure Smart Technology*	-	5.000
Congressional Add: *Low Carbon Hydrogen Technologies*	-	10.000
Congressional Add: *Microgrid Reliability and Resiliency*	-	10.000
Congressional Add: *Military Waste Stream Conversion*	-	5.000
Congressional Add: *Partnership and Technology Transfer*	-	4.000
Congressional Add: *Power Generation for Increased Facility Resilience Pilot*	-	10.000
Congressional Add: *Power Projection*	-	7.000
Congressional Add: *Sustainable Smart Utilities*	-	5.000
Congressional Add: *Water Resiliency and Self Sufficiency*	-	4.000
Congressional Add: *Water Reuse Consortium*	-	10.000
Congressional Add: *Watercraft Simulator*	-	4.000
Congressional Add Subtotals for Project: BO3	181.800	257.100
Congressional Add Totals for all Projects	181.800	257.100

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) BK8 / *Robotics for Engineer Operations Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BK8: *Robotics for Engineer Operations Adv Tech*	-	4.194	6.221	6.314	-	6.314	3.784	4.523	6.500	8.179	0.000	39.715
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates robotic engineer equipment capabilities that can remotely characterize the environment and operate in the battlespace for autonomous Combat Engineer actions. This Project provides technologies for Combat Engineer mission planning, creating or reducing barriers and obstacles, as well as maintaining, repairing, and constructing expedient infrastructure. These efforts will enhance Combat Engineer missions of mobility, counter mobility, and survivability through semi-autonomous or autonomous operations.

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

Research in this Project supports the Army Science and Technology Ground Portfolio.

Research is performed by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

Research in this Project is related to, and fully coordinated with Program Element (PE) 0602144A (Ground Technology) / Project BK7 (Robotics for Engineer Operations Technology).

Research in this PE complements PE 0602114A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology), and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Beyond-Visual-Line-of-Sight Tele-operated Engineer Operations Demonstration	4.194	5.994	6.314
Description: This effort matures and demonstrates remote control and semi-autonomous behaviors on small scale construction equipment to provide information that scales to larger legacy equipment as well as assess the applicability of small scale equipment working in collaboration and coordination.			
FY 2022 Plans: Demonstrate autonomous Engineer site characterization with a semantically labeled site model and change detection; demonstrate compact track loader and mini-hydraulic excavator performing Combat Engineer tasks at Beyond-Visual-Line-of-			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BK8 / *Robotics for Engineer Operations Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Sight (BVLOS) standoff distances to support mobility and maneuver; demonstrate a universal controller developed by Combat Capability Development Center Ground Vehicle Systems Center for Combat Engineer equipment. ***FY 2023 Plans:*** Will demonstrate operator assist capabilities for BVLOS execution of a Combat Engineer task. Will validate capabilities for autonomous Engineer site characterization and BVLOS teleoperation of multiple pieces of heavy Engineer equipment in a Joint exercise supporting Multi-Domain Operations. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.227	-
Accomplishments/Planned Programs Subtotals	4.194	6.221	6.314

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) BK9 / *Ground System Fluids and Fuels Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BK9: *Ground System Fluids and Fuels Adv Tech*	-	1.684	1.732	2.301	-	2.301	2.752	3.063	3.150	3.099	0.000	17.781
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates liquid logistics technologies such as enhanced jet fuels, lubricants, oils, powertrain fluids, coolants, bulk fluid treatment, monitoring, metering, storage, and distribution in support of established Army regulations and requirements. This Project improves products and technologies to optimize fuel efficiency, meet new hardware fluid requirements, modernize fluids, ensure bulk fluid meets quality requirements, and provide bulk fluid asset visibility, to optimize logistics and reduce logistics requirements. This Project executes the demonstration of enhanced jet fuels for ground systems, gear oils, anti-lock brake system - compatible brake fluid, smart bulk fuel metering and monitoring technologies. This Project improves liquid logistics products and technologies that are critical enablers for multi-domain operations requiring semi-independent operations to enable dispersed operations to extend operational reach, prolong endurance and allow freedom of action for the Joint Force.

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

Research in this Project supports the Army Science and Technology Ground Portfolio.

Research is performed by the United States (U.S.) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Ground System Fluids and Fuels	1.684	1.668	2.301
Description: This effort focuses on reducing the logistics footprint, improving fuel efficiency, and ensuring mobility by maturing and demonstrating technologies in areas such petroleum quality monitoring, filtration, storage and distribution, hydraulic fluids; enhanced jet fuels and fuel additives, lubricants, oil, powertrain fluids and coolants. Validates additional candidate synthetic fuel blends to determine their suitability for military ground systems. Validates candidate fuel efficient gear oils that maintain and improve vehicle axle durability and provide extended performance time over current gear oil for military use. Provide performance requirements for a new military brake fluid that is compatible with anti-lock braking system (ABS) and investigate candidate fluid technologies. Integrate smart fuel metering technology into self-correcting devices that automatically report fuel quantity and conduct fuel filter effectiveness testing to establish fuel particle contamination limits for new fuel monitoring technology.			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BK9 / *Ground System Fluids and Fuels Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
FY 2022 Plans: Will continue assessment of the lubrication capacity of fuel additive using improved methods and component test rigs for the initial fuel pump selected to optimize wear reduction of fuel delivery system components. Will conduct fuel injector testing based on the results of the fuel filter effectiveness testing to establish fuel particle contamination limits for new fuel monitoring technology. Will develop criteria and laboratory methodology to assess extended life and performance capabilities of coolants. ***FY 2023 Plans:*** Will correlate fuel lubricity additive concentration to fuel injection pump performance from the bench scale through test rig evaluation to full engine demonstrations for improved durability and operation using aviation fuels. Complete enhanced performance engine coolant candidate fluid testing and candidate down selection. Conduct testing to evaluate and establish smart meter performance baseline and initiate effort to transfer data via the server to a fuel dashboard. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Increase investment in fuel metering to provide fuel asset visibility and predictive logistics.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.064	-
Accomplishments/Planned Programs Subtotals	1.684	1.732	2.301

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) BL3 / *Explosives Forensics Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL3: *Explosives Forensics Advanced Technology*	-	2.002	2.096	2.214	-	2.214	2.246	2.267	2.267	2.267	0.000	15.359
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates instrumentation and algorithms required to provide improved point, proximity, and stand-off detection of explosives and precursor materials to enable the warfighter to integrate chemical and explosive hazard detection equipment. This Project integrates explosive detection into the family of Chemical, Biological, Radiological, and Nuclear point and stand-off sensors, alternative chemical detection modalities and algorithms that will improve the probability of detection and attribution of an explosive hazard or Home-made Explosive manufacturing/assembly location.

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

Research in this Project supports the Army Science and Technology Ground Portfolio.

Research is performed by the United States (U.S.) Army Engineer Research and Development Center and coordinated with the U.S. Army Futures Command.

Research in this Project is related to, and fully coordinated with Program Element (PE) 0602144A (Ground Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Detection Mechanisms for Contaminants	2.002	2.020	2.214
Description: This effort matures and demonstrates improved point and standoff detection of military and homemade explosives and their precursors, and other chemicals and hazardous materials. ***FY 2022 Plans:*** Will further mature novel portable detection technology for further maturity and testing of realistic threats and scenarios. Will continue maturation of photonic integrated circuit (PIC) for chemical sensing to decrease size, weight and power configuration footprint. ***FY 2023 Plans:*** Will demonstrate improved point and standoff detection of military homemade explosives and other chemical threats to facilitate chemical explosives reconnaissance focusing on integration to unmanned ground platforms. Will evaluate integrated systems for			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BL3 / *Explosives Forensics Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
semi-autonomous trace level detection of surface threats and vapor phase explosive and chemical threats. Will integrate maturing technologies in hyperspectral imaging, portable mass spectrometry, and advanced optical methodologies for sensor development. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.076	-
Accomplishments/Planned Programs Subtotals	2.002	2.096	2.214

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) BL6 / *Expedient Passive Protection Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL6: *Expedient Passive Protection Advanced Technology*	-	3.051	0.494	3.613	-	3.613	5.998	5.821	4.154	4.773	0.000	27.904
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates rapidly deployable protection solutions to protect small distributed units; decision support applications and software; and tactics, techniques, and procedures to increase the survivability of personnel, critical assets, and facilities from a range of threats. Force protection technologies will be matured and demonstrated for applications in complex and urban environments to protect against advanced energetic threats, large caliber rockets and missiles, and other emerging weapons.

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

Research in this Project supports the Army Science and Technology Ground portfolio.

Research in this Project conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

Research in this Project is related to and fully coordinated with Program Element (PE) 0602144A (Ground Technology) / Project BL5 (Expedient Passive Protection Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Force Protection in the Urban Environment Demonstrations ***Description:*** This effort matures and demonstrates force protection solutions for urban environments focusing on the use of existing structures; rapidly deployable protection systems; decision support applications and software; and tactics, techniques, and procedures to provide protection with consideration for a complex three-dimensional threat.	3.051	-	-
Title: Protection Against High Trajectory Large Caliber Rocket and Missile Threats ***Description:*** This effort matures and demonstrates expedient force protection solutions for emerging threats such as large caliber rocket and missile weapon effects. This effort also demonstrates decision support tools to aid the warfighter in selecting protection schemes for survivability from emerging threats supporting All-Domain/Multi-Domain Operations. ***FY 2022 Plans:***	-	0.476	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BL6 / *Expedient Passive Protection Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Assess capabilities of legacy protective systems to protect critical assets and facilities from emerging threat weapon system effects such as large caliber rockets and missiles to establish baseline performance. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding realigned based on completion of the baseline assessment phase and shift to Assessments of Solutions for Survivability from Emerging Threats (ASSET) Demonstrations effort in this project reflecting a planned shift in focus to include both legacy and newly developed expedient force protection solutions for emerging threats.			
Title: Assessments of Solutions for Survivability from Emerging Threats Demonstrations ***Description:*** This effort matures and demonstrates both legacy and newly developed expedient force protection solutions for emerging threats such as large caliber rocket and missle weapon effects and UAV threats. This effort also demonstrates algorithms for decision support applications and software; and inform tactics, techniques, and procedures (TTP's) to increase the survivability of personnel, critical assets, and facilities against emerging threats to enable the Warfighter to select protection schemes for survivability from emerging threats supporting Multi-Domain Operations. ***FY 2023 Plans:*** Will mature and demonstrate rapidly deployable protection systems (expedient barriers, expedient personnel shelters, and expeditionary bunkers) to protect critical semi-fixed assets and facilities from emerging threats such as large caliber rockets and missiles to establish baseline performance so these systems can be optimized to provide tailored protection. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding realigned to demonstrate passive protection capabilities developed in PE 0602144A (Ground Technology) / Project BL5 (Expedient Passive Protection Technology).	-	-	3.613
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.018	-
Accomplishments/Planned Programs Subtotals	3.051	0.494	3.613

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BL6 / *Expedient Passive Protection Advanced Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) BL8 / *Power Projection in A2AD Environments Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL8: *Power Projection in A2AD Environments Adv Tech*	-	1.220	2.970	4.948	-	4.948	3.302	4.101	2.660	3.699	0.000	22.900
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates remote assessment technologies to determine entry and maneuver corridors, provides site selection tools and decision support technologies for all climates in all season conditions including aviation site- selection tools, enhanced automated route reconnaissance technologies, mobility models for extreme climates, and road capacity assessment technologies. These technologies reduce reliance on manned on-site reconnaissance for force projection assessments and provide all-season predictions to ensure air and ground battlespace entry and maneuver. This Project also matures and demonstrates material solutions to repair, rebuild, and construct infrastructure required for movement and maneuver in highly contested, complex operational environments such as Anti-Access/Area Denial.

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

Research in this Project supports the Army Science and Technology Ground portfolio.

Research in this Project conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with the U.S. Army Futures Command.

Research in this Project is related to and fully coordinated with Program Element (PE) 0602144A (Ground Technology) / Project BL7 (Power Projection in A2AD Environments Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Entry and Sustainment in Complex Contested Environments Demonstrations	1.220	1.522	3.312
Description: This effort matures and demonstrates geospatial planning tools to expand engineering analysis of ground surfaces for entry, sustainment, and maneuver operations and to automate processes for selecting suitable maneuver corridors.			
FY 2022 Plans: Mature and demonstrate reconnaissance techniques and mobility algorithms for maneuver in arctic regions; and demonstrate advanced analysis methods for classifying low-volume roads and predicting deterioration under military vehicle loadings.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BL8 / *Power Projection in A2AD Environments Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will mature and demonstrate planning capabilities for predicting route deterioration from military ground vehicles; will demonstrate methods for assessing ground mobility across snow-covered terrain and thawing artic soils to inform Army tactics, techniques, and procedures (TTP). ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase provides for the final year of demonstration events for this effort completing in Fiscal Year 2023.			
Title: Engineering for Battlespace Maneuver Demonstrations ***Description:*** This effort demonstrates material solutions and techniques for expedient repair to rapidly repair and upgrade damaged infrastructure along mobility corridors and restaging areas to maintain and enhance freedom of maneuver achieving overmatch and tactical advantage in contested complex environments. ***FY 2022 Plans:*** Will demonstrate techniques for rapid soil stabilization to support military ground vehicle maneuver; and will demonstrate tactics, techniques, and procedures as well as material solutions for rapid infrastructure capacity upgrades. ***FY 2023 Plans:*** Will demonstrate effectiveness of material additives for stabilizing reclaimed pavement materials; will mature and demonstrate equipment solutions for expedient road repair. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.	-	1.340	1.636
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.108	-
Accomplishments/Planned Programs Subtotals	1.220	2.970	4.948

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BL8 / *Power Projection in A2AD Environments Adv Tech*

C. Other Program Funding Summary ($ in Millions)

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) BM1 / *Protection from Advanced Weapon Effects Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BM1: *Protection from Advanced Weapon Effects Adv Tech*	-	2.104	5.868	4.856	-	4.856	4.915	5.103	5.302	5.490	0.000	33.638
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates structural hardening solutions and force protection technologies to increase survivability of facilities and provide critical updates to protective design specifications and guidance. Additionally, this project matures and demonstrates passive protection technologies and provides protective design criteria advancements to mitigate attack from emerging advanced threats.

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

Research in this Project supports the Army Science and Technology Ground portfolio.

Research in this Project is conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This Project is related to and fully coordinated with Program Element (PE) 0602144A (Ground Technology) / Project BL9 (Protection from Advanced Weapon Effects Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Defeat of Complex Attack Demonstrations	2.104	5.654	4.856
Description: This effort demonstrates force protection technologies that mitigate the effects of emerging peer and near peer adversaries advanced penetrating threats and high yield blast effects by optimizing high-performance, logistically feasible material solutions and processes.			
FY 2022 Plans: Demonstrate optimized subscale hardening solutions against emerging complex weapon attack scenarios; and optimize damage prediction and system performance for full-scale demonstration.			
FY 2023 Plans: Will demonstrate full scale structural hardening solution against emerging complex weapon attack scenario. Will demonstrate enhanced algorithm for structural hardening and damage prediction from peer and near peer adversaries' precision strike penetrating weapons.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BM1 / *Protection from Advanced Weapon Effects Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding decrease reflects planned lifecycle of this effort completing in Fiscal Year 2023.			
Title: FY 2022 SBIR/STTR Transfer	-	0.214	-
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	2.104	5.868	4.856

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army											Date: April 2022	
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*				Project (Number/Name) BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*			
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
BO3: *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*	-	181.800	257.100	-	-	-	-	-	-	-	0.000	438.900
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Military Engineering Technology Demonstration.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Congressional Add: Electrical System Safety and Reliability ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Electrical System Safety and Reliability. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Electrical System Safety and Reliability	5.000	5.000
Congressional Add: Cold Regions Research ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Cold Regions Research. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Cold Weather Research Station	2.000	2.000
Congressional Add: High-Performance Concrete Technology ***FY 2021 Accomplishments:*** Program Increase supported advanced research on High-Performance Concrete Technology. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for High-Performance Contrete	6.000	6.000
Congressional Add: Secure Management of Energy Generation and Storage	5.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: Program Increase supported advanced research on Secure Management of Energy Generation and Storage. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Secure Management of Energy Generation and Storage		
Congressional Add: Composite Flywheel Technology ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Composite Flywheel Technology. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Composite Flywheel Technology	7.000	7.000
Congressional Add: Robotic Construction Equipment ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Robotic Construction Equipment Work executed by Army Futures Command.	5.000	-
Congressional Add: Environmental Sensors for Explosives ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Environmental Sensors for Explosives. Work executed by Army Futures Command.	3.000	-
Congressional Add: Robotic 4-D Printing of Geopolymer-Based Composites ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Robotic 4-D Printing of Geopolymer-Based Composites. Work executed by Army Futures Command.	2.000	-
Congressional Add: Materials and Manufacturing Technology for Cold Environments	4.000	4.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: Conduct advanced research in Materials and Manufacturing Technology for Cold Environments. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Materials and Manufacturing Technology for Cold Environments		
Congressional Add: Research Facility Modernization ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Research Facility Modernization. Work executed under the direction of the Army Futures Command.	6.000	-
Congressional Add: Program Increase - Smart Installation and Community Program ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Smart Installation and Community Program. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - Flow Battery Demonstration ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Flow Battery Demonstration. Work executed by Army Futures Command.	20.000	-
Congressional Add: Program Increase - Corrosion Protection and Prevention ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Corrosion Protection and Prevention. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase - Rapid Entry and Sustainment for the Arctic ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Rapid Entry and Sustainment for the Arctic.	8.000	8.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Rapid Entry and Sustainment for the Arctic		
Congressional Add: Program Increase - Secure Management of Energy Generation and Storage ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Secure Management of Energy Generation and Storage. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - Water Quality and Resiliency ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Water Quality and Resiliency. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Water Quality and Resiliency Technologies	5.000	5.000
Congressional Add: Program Increase - Rare Earth Element Extraction ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Rare Earth Element Extraction. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - Organic Light Emitting Diode ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Organic Light Emitting Diode. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Organic Light Emitting Diode	5.000	5.000
Congressional Add: Program Increase - Coatings Technology ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Coatings Technology. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program increase - Heavy Load Simulator ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Heavy Load Stimulator.	4.200	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command.		
Congressional Add: Program Increase - Integrated Microgrids ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Integrated Microgrids. Work executed by Army Futures Command.	4.000	-
Congressional Add: Program Increase - Infrastructure Resilience and Flood Assessment ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Infrastructure Resilience and Flood Assessment. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Infrastructure Resilience and Flood Assessment	3.000	3.500
Congressional Add: Program Increase - Single Connection Quick Oil Change System ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Single Connection Quick Oil Change System. Work executed by Army Futures Command.	3.000	-
Congressional Add: Program Increase - Clean Modular Hydro Technology ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Clean Modular Hydro Technology. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Clean Modular Hydro Technology.	4.000	8.000
Congressional Add: Program Increase - Accelerator Technology for Ground Maneuver ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Accelerator Technology for Ground Maneuver.	5.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Accelerator Technology for Ground Maneuver		
Congressional Add: Program increase - Autonomous Combat Engineering Solutions ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Autonomous Combat Engineering Solutions. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Autonomous Combat Engineering Solutions	5.500	4.000
Congressional Add: Program Increase - Coastal Terrain Hazard Research ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Costal Terrain Hazard Research. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Coastal Terrain Hazard Research	8.000	6.000
Congressional Add: Program Increase - Expeditionary Deployment of Fully Sustainable Utility ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Expeditionary Deployment of Fully Sustainable Utility. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase - Graphene Research ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Graphene Research. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - Impacts of Soil Structures on Hydrology ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Impacts of Soil Structures on Hydrology.	4.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Impacts of Soil Structures on Hydrology		
Congressional Add: Program Increase - Operational Energy Research ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Operational Energy Research. Work executed by Army Futures Command.	1.300	-
Congressional Add: Program Increase - Temperature Insensitive High?Energy Density Lithium?Ion Batteries ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Temperature Insensitive High-Energy Density Lithium-Ion Batteries. Work executed by Army Futures Command.	2.500	-
Congressional Add: Program Increase - Vehicle Performance Reliability and Operations ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Vehicle Performance Reliability and Operations. Work executed by Army Futures Command.	3.000	-
Congressional Add: Program Increase - Cross-Laminated Timber and Recycled Carbon Fiber Materials ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Cross-Laminated Timber and Recycled Carbon Fiber Materials. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Cross-Laminated Timber and Recycled Carbon Fiber Materials	1.300	5.500
Congressional Add: Program Increase - Advanced Explosion Resistant Window Systems ***FY 2021 Accomplishments:*** Program Increase supported advanced research on Advanced Explosion Resistant Window Systems. Work executed by Army Futures Command.	5.000	-
Congressional Add: 3D Printing of Concrete	-	2.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2022 Plans: Congressional Interest Item funding provided for 3D Printing of Concrete		
Congressional Add: 3D Printing of Infrastructure ***FY 2022 Plans:*** Congressional Interest Item funding provided for 3D Printing of Infrastructure	-	5.000
Congressional Add: Additive Construction for Field Deployment ***FY 2022 Plans:*** Congressional Interest Item funding provided for Additive Construction for Field Deployment	-	4.000
Congressional Add: Anticipating Threats to Natural Systems ***FY 2022 Plans:*** Congressional Interest Item funding provided for Anticipating Threats to Natural Systems	-	5.000
Congressional Add: Army Visual and Tactical Arctic Reconnaissance ***FY 2022 Plans:*** Congressional Interest Item funding provided for Army Visual and Tactical Arctic Reconnaissance	-	2.000
Congressional Add: Assessments and Monitoring Systems for Historic Structures ***FY 2022 Plans:*** Congressional Interest Item funding provided for Assessments and Monitoring Systems for Historic Structures	-	5.000
Congressional Add: Autonomous Construction and Manufacturing ***FY 2022 Plans:*** Congressional Interest Item funding provided for Autonomous Construction and Manufacturing	-	5.000
Congressional Add: Biofuel ***FY 2022 Plans:*** Congressional Interest Item funding provided for Biofuel	-	6.000
Congressional Add: Biomass Polymer Technology ***FY 2022 Plans:*** Congressional Interest Item funding provided for Biomass Polymer Technology	-	2.000
Congressional Add: Cold Weather Energy Research ***FY 2022 Plans:*** Congressional Interest Item funding provided for Cold Weather Energy Research	-	5.000
Congressional Add: Cold Weather Research ***FY 2022 Plans:*** Congressional Interest Item funding provided for Cold Weather Research	-	3.000
Congressional Add: Distributed Technologies for Steam Loop Replacements	-	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2022 Plans: Congressional Interest Item funding provided for Distributed Technologies for Steam Loop Replacements		
Congressional Add: Electrochemical Conversion of Water Streams	-	5.000
FY 2022 Plans: Congressional Interest Item funding provided for Electrochemical Conversion of Water Streams		
Congressional Add: Entry Control Points at Installations	-	5.000
FY 2022 Plans: Congressional Interest Item funding provided for Entry Control Points at Installtions		
Congressional Add: Expeditionary Additive Construction	-	15.000
FY 2022 Plans: Congressional Interest Item funding provided for Expeditionary Additive Construction		
Congressional Add: Explosive Materials Detection	-	3.000
FY 2022 Plans: Congressional Interest Item funding provided for Explosive Materials Detection		
Congressional Add: Frost Heave Effects Monitoring	-	4.500
FY 2022 Plans: Congressional Interest Item funding provided for Frost Heave Effects Monitoring		
Congressional Add: Graphene Applications for Military Engineering	-	10.000
FY 2022 Plans: Congressional Interest Item funding provided for Graphene Applications for Military Engineering		
Congressional Add: Hardened Facility Standards	-	4.600
FY 2022 Plans: Congressional Interest Item funding provided for Hardened Facility Standards		
Congressional Add: High Power Fast Charging for Electric Vehicle Fleets	-	3.000
FY 2022 Plans: Congressional Interest Item funding provided for High Power Fast Charging for Electric Vehicle Fleets		
Congressional Add: Infrastructure Smart Technology	-	5.000
FY 2022 Plans: Infrastructure Smart Technology		
Congressional Add: Low Carbon Hydrogen Technologies	-	10.000
FY 2022 Plans: Congressional Interest Item funding provided for Low Carbon Hydrogen Technologies		
Congressional Add: Microgrid Reliability and Resiliency	-	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2022 Plans: Congressional Interest Item funding provided for Microgrid Reliability and Resiliency		
Congressional Add: Military Waste Stream Conversion ***FY 2022 Plans:*** Congressional Interest Item funding provided for Military Waste Stream Converison	-	5.000
Congressional Add: Partnership and Technology Transfer ***FY 2022 Plans:*** Congressional Interest Item funding provided for Partnership and Technology Transfer	-	4.000
Congressional Add: Power Generation for Increased Facility Resilience Pilot ***FY 2022 Plans:*** Congressional Interest Item funding provided for Power Generation for Increased Facility Resilience Pilot	-	10.000
Congressional Add: Power Projection ***FY 2022 Plans:*** Congressional Interest Item funding provided for Power Projection	-	7.000
Congressional Add: Sustainable Smart Utilities ***FY 2022 Plans:*** Congressional Interest Item funding provided for Sustainable Smart Utilities	-	5.000
Congressional Add: Water Resiliency and Self Sufficiency ***FY 2022 Plans:*** Congressional Interest Item funding provided for Water Resiliency and Self Sufficiency	-	4.000
Congressional Add: Water Reuse Consortium ***FY 2022 Plans:*** Congressional Interest Item funding provided for Water Reuse Consortium	-	10.000
Congressional Add: Watercraft Simulator ***FY 2022 Plans:*** Congressional Interest Item funding provided for Watercraft Simulator	-	4.000
Congressional Adds Subtotals	181.800	257.100

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) CJ9 / *Ground Enabling University Adv Development*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CJ9: *Ground Enabling University Adv Development*	-	-	4.009	3.896	-	3.896	4.195	6.002	6.097	6.095	0.000	30.294
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Project matures and demonstrates advanced developments and technological innovations from academia, in the focus areas of ground autonomy, Artificial Intelligence / Machine Learning (AI/ML) and robotics, occupant/vehicle survivability and other ground platform technologies of importance to the Army, by maturing and demonstrating technologies with the goal of delivering technology to the warfighter more quickly. This Project matures and demonstrates advanced technologies with a focus on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies critical to the next generation combat vehicles. This Project focuses on maturation and demonstration of various advanced technologies originating from extramural applied research in academia pertaining to navigation/ routing, autonomous robotic vehicles with the use of artificial intelligence and machine learning as applied to ground mobility and maneuver, and other innovative ground enabling applied research technologies. This Project also matures and demonstrates advanced technologies leading to potential emerging capabilities in areas of strategic importance to the Army in autonomy, robotics and AI/ML, protection of both platform and occupant, and other ground platform technologies in propulsion, survivability, powertrain, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances.

Research in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

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

Research in this Project is performed by the United States (US) Army Futures Command.

Research in this Project is done in coordination with Program Element (PE) 0620144A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Robust autonomous capabilities for ground vehicles	-	2.136	1.959
Description: This effort demonstrates AI/ML and autonomous mobility integrated into ground vehicles to conduct off-road maneuvers to enable the transition from teleoperation to fully-autonomous or semi-autonomous scenarios. Research is conducted in collaboration with university partners to advance autonomous mobility and protection of both occupant and platform in optionally manned and autonomous ground vehicles.			
FY 2022 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** CJ9 / *Ground Enabling University Adv Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will further mature, integrate and demonstrate use of AI/ML methods to enable robust, autonomous, tactical behaviors for multi-agent air and ground vehicle teams beyond existing behaviors such as leader-follower (e.g., flanking, occupying); as well as increase the speed of autonomous behavior acquisition through effective navigation and route planning using techniques to identify terrain features in images and transfer of simulator-learned behaviors to developmental ground platforms. Mature and demonstrate methods of shared control (between human operators and AI/ML systems) that increase overall autonomous system performance with human input. ***FY 2023 Plans:*** Will further mature, integrate and demonstrate use of AI/ML methods that enable robust, autonomous, tactical behaviors for multi-agent air and ground vehicle teams beyond existing behaviors on common software platforms and Army experimental platforms. Will continue to mature and demonstrate emerging autonomous technologies to increase the overall system performance of the autonomy software platforms through academia. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects realignments to PE 0603116A (Lethality Advanced Technology) / Project CG2 (Lethality Enabling University Adv Development) and PE 0603042A (C3I Advanced Technology) / Project CN3 (Network Enabling University Adv Development).			
Title: Human-robot/AI interactions	-	1.727	1.937
Description: This effort matures, integrates, and demonstrates systems involving physical and cognitive levels of interactions between humans and robots, with the use of reinforcement machine learning which uses human feedback, learning from demonstrations, and safe human-aware controllers. Work is conducted in collaboration with university partners to advance autonomous mobility as well as other areas of ground platform technologies in propulsion, survivability, powertrain, sensing, and perception. ***FY 2022 Plans:*** Will further mature, integrate and demonstrate use of AI/ML methods to improve autonomous systems by capturing and learning from human teleoperation commands, human interventions, and other forms of human interaction (e.g., spoken language). Will mature and demonstrate tactics and algorithms on common software platforms which enable robots to deal with complex environments on the fly while working fully autonomously around humans for extended periods of time. ***FY 2023 Plans:*** Will further mature, integrate and demonstrate use of AI/ML methods to improve autonomous systems by capturing and learning from human teleoperation commands, human interventions, and other forms of human interaction. Will mature and demonstrate			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** CJ9 / *Ground Enabling University Adv Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
tactics and algorithms on common software platforms and Army experimental platforms through academia while working fully autonomously around humans for extended periods of time. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.146	-
Accomplishments/Planned Programs Subtotals	-	4.009	3.896

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) CV5 / *Engineer Enablers Maneuver, LOG, & Sustainment Adv*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CV5: *Engineer Enablers Maneuver, LOG, & Sustainment Adv*	-	-	-	2.539	-	2.539	3.298	4.781	2.183	3.586	0.000	16.387
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2023.

This is a New Start Project in Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project matures and demonstrates joint contested logistics operations technologies and provides capabilities to operate in disbursed battlefield operations and support sustainment operations through predicted dynamic scenario development that provides critical vulnerabilities assessment and methods/equipment to mitigate potential issues.

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

Research is performed at the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This research complements Program Element (PE) 0602144A (Ground Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Sustainment Planning Tool	-	-	2.539
Description: This effort will mature and demonstrate map-based sustainment running estimates with preposition of survivable material stockpiles based on synchronized ops/intel/log running estimates and informed by artificial intelligence (AI) based edge computing analyses.			
FY 2023 Plans: Will mature and optimize the existing Joint Planning Services (JPS)-developed Sustainment Quick Estimate model to connect to appropriate authoritative data sources and provide more robust capabilities for Sustainment Running Estimates (SRE).			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** CV5 / *Engineer Enablers Maneuver, LOG, & Sustainment Adv*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
This is a New Start for FY23.			
Accomplishments/Planned Programs Subtotals	-	-	2.539

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / *Ground Advanced Technology*	Project (Number/Name) DA2 / *SAFR Alternatives for Readiness Advanced Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DA2: *SAFR Alternatives for Readiness Advanced Tech*	-	-	-	1.865	-	1.865	2.913	4.261	5.199	5.509	0.000	19.747
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2023.

This is a New Start Project in Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project demonstrates cross-cutting, safer alternative advanced technologies that enable readiness. These technologies also support product availability, Soldier and worker safety, and a reduced environmental footprint in the manufacturing, maintenance, and use of ground vehicles and other Army weapon systems. The Project matures and optimizes safer alternatives in technology areas including surface finishes, coatings, solvents, refrigerants, and fire suppressants. This research addresses the growing impacts to health and readiness associated with carcinogens like hexavalent chromium, global warming chemicals like hydrofluorocarbons (HFCs) and persistent toxins like per- and polyfluoroalkyl substances (PFAS) (forever chemicals). This Project enables the Army to assess and resolve these types of emerging and continually evolving risks throughout the full life cycle of Army systems.

The cited research is consistent with the Army Modernization Strategy and provides enabling technologies in support of all Cross Functional Teams.

Research in this Project is performed by the United States (U.S.) Army Combat Capabilities Development Command (DEVCOM) Army Research Laboratory, Aberdeen Proving Ground, MD; the Armaments Center, Picatinny Arsenal, NJ; the Aviation and Missile Center, Huntsville, AL; the Soldier Center, Natick, MA; and the Ground Vehicle Systems Center, Warren, MI; and is coordinated with the United States (U.S.) Army Futures Command.

This Project complements and transitions technologies developed under Program Element (PE) 0602144A (Ground Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Safer Alternatives for Readiness (SAFR) Advanced Technology	-	-	1.865
Description: Demonstrate safer alternative advanced technologies to replace hexavalent chromium, cadmium and other harmful chemicals during surface finishing; reduce the use of volatile organic compounds and other hazardous materials in coating and depainting processes; and ensure the availability of compatible next generation refrigerants and fire suppressants with low global warming potential.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603119A / *Ground Advanced Technology*	**Project (Number/Name)** DA2 / *SAFR Alternatives for Readiness Advanced Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will demonstrate advanced non-chromium surface finishing techniques for use on ground systems; will mature non-chemical depainting alternatives to n-methyl pyrrolidone; and will optimize the performance of HFC alternatives against military-unique requirements for refrigerants and fire suppressants. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This Project is a new start in FY23.			
Accomplishments/Planned Programs Subtotals	-	-	1.865

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A