WORK ZONE RESERVATION AND TRAVELER INFORMATION SYSTEM

ATCMTD Proposal 2017

VOLUME I

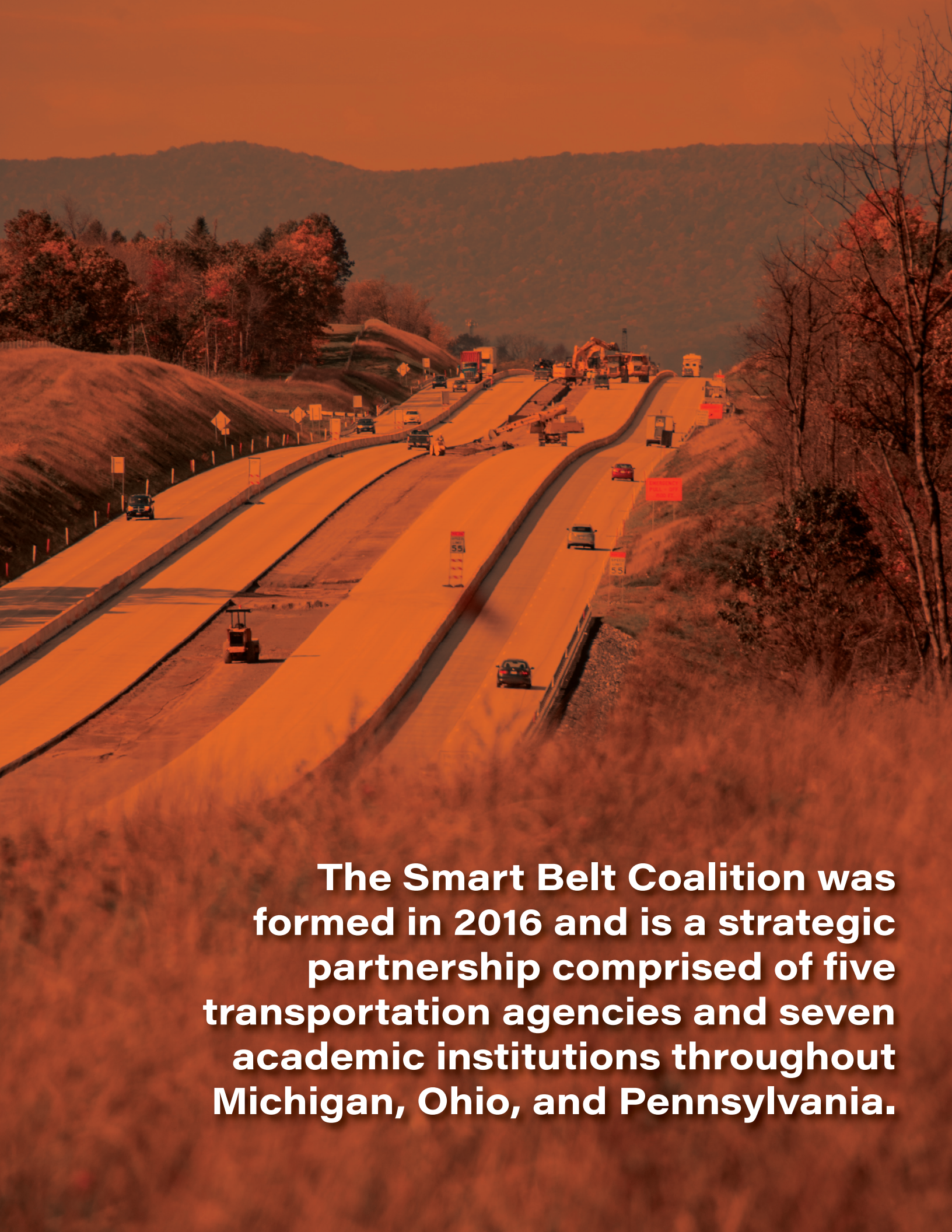
OHIO TURNPIKE AND INFRASTRUCTURE COMMISSION 1949

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

PENNA TURN PIKE

pennsylvania DEPARTMENT OF TRANSPORTATION

MDOT Michigan Department of Transportation



The Smart Belt Coalition was formed in 2016 and is a strategic partnership comprised of five transportation agencies and seven academic institutions throughout Michigan, Ohio, and Pennsylvania.

PROJECT NAME	Work Zone Reservation and Traveler Information System
ELIGIBLE ENTITY APPLYING	Pennsylvania Turnpike Commission on behalf of the Smart Belt Coalition, a multijurisdictional group
TOTAL PROJECT COST	$7,877,000
ATCMTD REQUEST	$3,900,000
ARE MATCHING FUNDS RESTRICTED?	No
PROJECT LOCATION	Michigan, Ohio, and Pennsylvania
PROGRAMMED IN TRANSPORTATION PLANS?	No
TECHNOLOGIES TO BE DEPLOYED	Advanced Traveler Information Systems; Advanced Transportation Management Technologies

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1 Project Description

1. Introduction

Executive Summary

WZRTIS

Proposed Technology Deployments

- Advanced Traveler Information Systems
- Advanced Transportation Management Technologies

Through the Smart Belt Coalition, the Michigan Department of Transportation (MDOT), Ohio Department of Transportation (ODOT), Ohio Turnpike and Infrastructure Commission (OTIC), Pennsylvania Department of Transportation (PennDOT), and the Pennsylvania Turnpike Commission (PTC) are advancing the development and deployment of a $7,877,000 Work Zone Reservation and Traveler Information System (WZRTIS). The WZRTIS will enhance work zone operations and safety by providing accurate and consistent work zone information across nearly 70,000 miles of roadway, from Michigan's international border with Ontario through Ohio and Pennsylvania. The system will streamline work zone coordination between maintenance and construction crews, utilities, operation managers, and other agencies operating within the roadways.

Upon completion, the project will modernize work zone scheduling, management, and information sharing to fundamentally improve the way Michigan, Ohio, and Pennsylvania manage work zones. The WZRTIS will feature the following capabilities.

- **Multi-User Lane Reservation and Conflict Resolution:** The system will be an innovative solution where multiple agencies and partners will cooperatively identify times of the day when roadways or parts of roadways can or cannot be reserved for roadwork, based on each agency's respective rules and restrictions for lane closures. The system will also scan for lane closure conflicts and manage the approval process for lane reservations, serving as a common platform to supplement or replace the individualized, manual processes that are used today. In addition to work zones within each respective state, the system will also address interjurisdictional work zones that may cross state lines. Data elements that are part of this application will be standardized between all agencies, allowing for easier integration into existing and future traveler information and connected vehicle applications.
- **Traveler Information:** Automated data feeds from each Coalition agency, following a single defined format, will ensure traveler information systems and third party providers of traffic and navigation applications receive real-time work zone data instantaneously for Michigan, Ohio, and Pennsylvania. The system will provide precise and reliable information across the agencies, improving the overall operational awareness for motorists and freight operators.
- **Vehicle to Infrastructure (V2I):** To support future functionality, the system will be designed to serve as a foundation for future system requirements for V2I applications, such as lane reduction warnings or reduced speed warnings. Current pilot deployments of these applications indicate that the location of work zones is a critical input element for application functionality. This system will serve as the basis for providing accurate work zone locations, which can then be used by automobile companies, suppliers, and others to further develop work-zone V2I applications.

  Future phases could include integrating other data sources, including from vehicles, to gain the ability to detect and verify mobile construction and maintenance activities and to detect precise lane closure configurations in real-time or near-real-time.
- **Open System:** The Coalition is proposing to develop the system using an open platform to ensure future scalability to local municipalities, partners, and other state transportation agencies. Agencies would have the ability to integrate the WZRTIS into their own ITS, operational, and data systems and processes, and would manage ongoing maintenance and operations. If expanded as envisioned, the WZRTIS has the potential to improve work zone operations and safety across the nation.

The project will improve safety and mobility across the three states by providing more advanced notice of closures to motorists, reducing conflicts between lane closures, and providing better situational awareness to participating agencies.

Grant Request

The Smart Belt Coalition is requesting $3,900,000 in grant funding through the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Initiative for this project. ATCMTD grant funding will be matched by $3,900,000 in non-federal funding (for a total of $7,800,000) from the five agencies (MDOT, ODOT, OTIC, PennDOT, and PTC) and will be used to develop, deploy, and evaluate the WZRTIS in Michigan, Ohio, and Pennsylvania. In addition, the agencies will provide additional funds if needed to complete the project, which is estimated at $7,877,000.

Project Approach

The agencies are proposing a three-phase project. Critical project milestones include the following, assuming a project start date of October 1, 2017:

PHASING	Completion Milestones
Phase 1	
Planning and Systems Engineering Documentation	September 30, 2018
Initial System Procurement	March 31, 2019
Phase 2	
System Development and Initial Deployment	December 31, 2019
Phase 3	
Individual Agency Integration (Full Deployment)	June 30, 2020
System Evaluation	June 30, 2021

Table 1: Project Schedule Milestones

Based on the project schedule, the Smart Belt Coalition anticipates initial deployment of the system by December 31, 2019. Full integration into the participating agencies systems and processes will be completed in June 2020, with a one-year evaluation period ending in June 2021. The total project cost is estimated at $7,877,000.

Applicant Collaboration

The project is part of a new, multi-year strategic planning effort underway by the Smart Belt Coalition to advance large scale projects that benefit from a multi-agency, multi-state development and deployment. As a direct outcome of collaborative agency planning efforts since May 2016, the development and deployment of the WZRTIS has been prioritized as the top project for the Coalition to undertake. An ATCMTD grant will strengthen the project in a number of ways but, most critically, it will continue to drive forward the momentum of work and collaboration that has been completed to date.

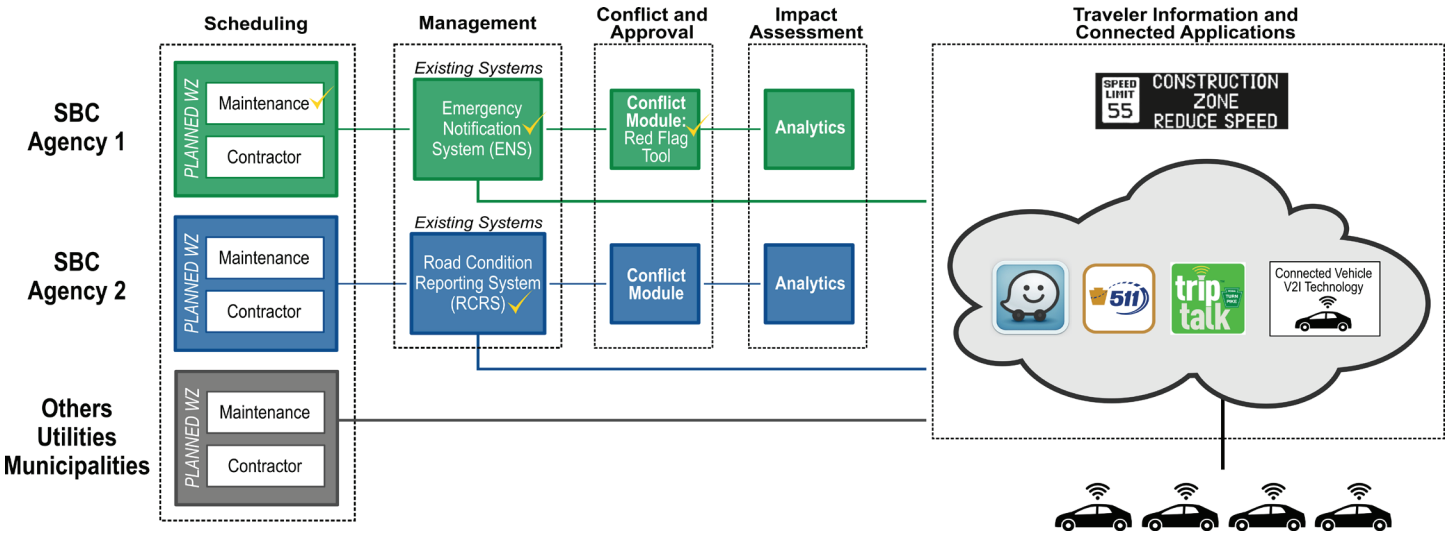
The Smart Belt Coalition is the first long-term multi-state collaboration in the transportation industry. The Coalition is paving a foundation for other jurisdictions to join in this historic partnership, or to replicate it in other portions of the country, and represents the beginning of a continued effort to make our highways safer, cleaner, and more efficient.

With an aging transportation infrastructure across the nation, capital spending in surface transportation will continue to grow, resulting in thousands of work zones every year. By working together to deploy an open platform system for work zone management, Michigan, Ohio, and Pennsylvania will achieve economies of scale while providing an open platform that can potentially be adopted as a single unified national system.

Project Need

Based on Federal Highway Administration (FHWA) statistics, there were 669 fatalities from crashes in work zones in 2014, or 1.8 work zone fatalities per day, and an estimated 47,758 injuries, or approximately 131 work zone injuries every day. In 2014, INRIX estimated that motorists lost a total of 6.9 billion hours due to work zone-related delays.

The Smart Belt Coalition understands the promise that automated and connected vehicles hold for roadway safety, and the fact that work zone-related V2I applications are being developed; however, without consistent processes and accurate work zone information provided for public roadways, the higher technology functions of connected and automated vehicle systems cannot be realized.

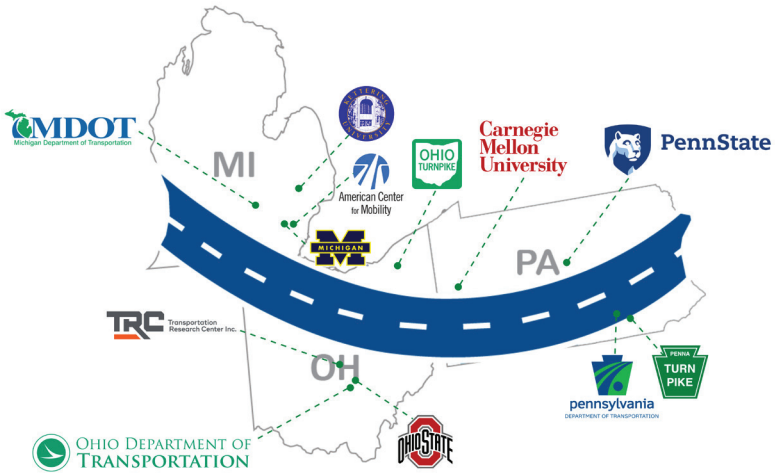


Work Zone Reservation Concept Overview

2. About the Applicant

Applicant

MDOT, ODOT, OTIC, PennDOT, and the PTC are submitting this ATCMTD application as a multijurisdictional group operating under the Smart Belt Coalition. For the purposes of ATCMTD, the PTC is filing the application on behalf of the five agencies, will serve as the lead agency to manage grant funding that may be awarded to the project, and will serve as the overall Project Manager.



Smart Belt Coalition

The Smart Belt Coalition was formed in 2016 and is a strategic partnership comprised of twelve organizations, including five transportation agencies and seven research and academic institutions, located throughout Michigan, Ohio, and Pennsylvania. The Coalition is focused on advancing connected and automated vehicle technologies and fosters collaboration in the areas of research, testing, policy, standards development, deployment, and outreach.

Smart Belt Coalition member agencies and organizations include:

- Michigan Department of Transportation
- Ohio Department of Transportation
- Ohio Turnpike and Infrastructure Commission
- Pennsylvania Department of Transportation
- Pennsylvania Turnpike Commission
- University of Michigan
- American Center for Mobility
- Kettering University
- Ohio State University
- Transportation Research Center
- Carnegie Mellon University
- Pennsylvania State University

To establish the Coalition, a Letter of Understanding (LOU) was fully executed in May 2017 between MDOT, ODOT, OTIC, PennDOT, and the PTC. The LOU specifies the agencies' intent to participate in the Coalition for purposes of advancing automated and connected vehicle infrastructure technology and to enhance safety, mobility, economic competitiveness, and overall quality of life of the partner states through strategic deployment of innovative technologies. A copy of the LOU is enclosed and labeled "SBC LOU." In addition, Coalition members are establishing a Pooled Fund Study structure to support, guide, and implement its Strategic Plan.

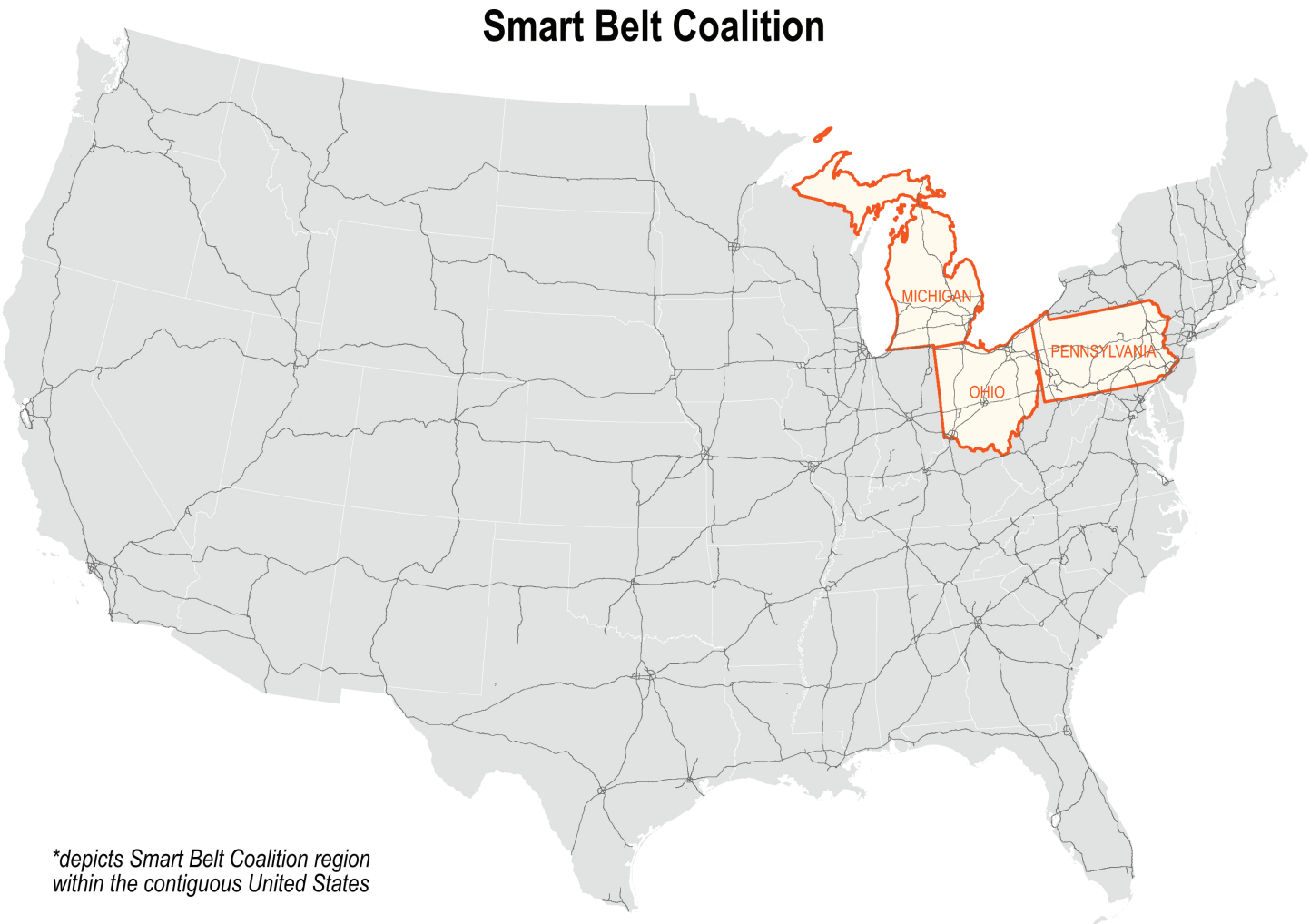
Since its formation, the Smart Belt Coalition has been approached by other organizations located within or adjacent to the tristate area who have expressed interest in joining the Coalition. The existing agencies and research affiliates welcome continued and expanded collaboration, and anticipate membership growth in the future.

Coalition Strategic Planning

In 2016, the Smart Belt Coalition initiated a strategic planning process to develop a needs-based Strategic Plan for the Coalition. Based on a careful existing conditions and assets analysis, the five member agencies each identified their top four priorities. In result of the exercise, three service layers emerged as priorities for the Coalition, including work zones, traffic incident management, and freight. Work zones were unanimously identified as the top shared priority and the Coalition has since taken the results of the Strategic Plan to define, plan, and advance the WZRTIS.

Grant Administration

Funding for the WZRTIS will be managed by the PTC's Project Manager Amber Reimnitz, PMP. Amber has 11 years of experience managing traffic operations and ITS projects, and is highly proficient in procurement, grant administration, and financial reporting. Her efforts will be supported by Planning Manager, Joe Sutor, P.E., who is responsible for overseeing the implementation of the PTC's Ten-year Capital Plan. To manage its Capital Plan and projects like the WZRTIS, the PTC utilizes SAP enterprise application software developed specifically for the PTC. SAP allows the PTC to accurately track and report on all sources of revenue, and is an exceptional tool for managing the grant administration process associated with funding awards.



depicts Smart Belt Coalition region within the contiguous United States

3. Project Location

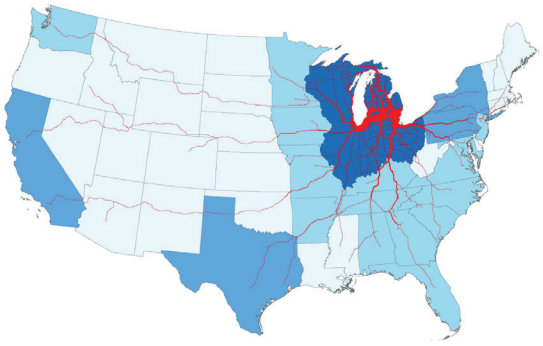
Geographic Reach

Unique to the Smart Belt Coalition, the proposed WZRTIS will be deployed across a three-state area under the jurisdiction of the state DOTs and toll agencies in Michigan, Ohio, and Pennsylvania. The system's deployment will include 173,858 lane miles and will affect the collective 362.5 billion annual vehicle trips that occur on Michigan, Ohio, and Pennsylvania roadways each year.

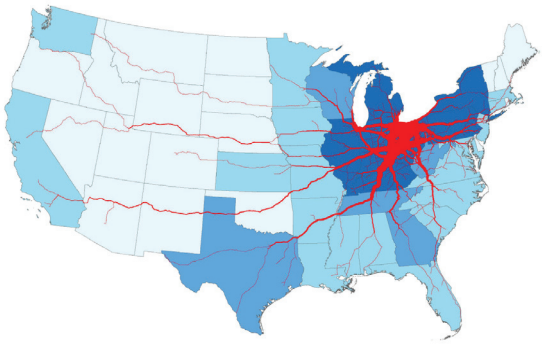
From an economic outlook, Michigan, Ohio, and Pennsylvania together represent a portion of the U.S. economy that rivals California and Texas, generating $1.8 trillion in gross domestic product in 2016. The three states are home to 34.3 million residents and the metropolitan hubs of Philadelphia, Pittsburgh, Columbus, Cleveland, and Detroit. These cities and the surrounding suburban communities comprise a large portion of the Great Lakes Megaregion as well as a portion of the Northeast Megaregion. Connecting the two Megaregion hubs, Michigan, Ohio, and Pennsylvania each feature prominent freight corridors that are vital routes for the distribution of raw materials and finished goods to and from the Great Lakes region and some of the nation's largest consumer markets in the Northeast. Collectively, the tristate region trades, or moves, more than 14 percent of all national goods valued at more than $2.8 trillion domestically and internationally.

In addition, Michigan's international crossings with Canada supports international commerce and the flow of imports and exports. According to the Bureau of Transportation Statistics, the international border crossing in Detroit handles the highest volume of freight traffic of all land crossings with Canada, and is the second highest international border crossing by freight volume in all of North America.

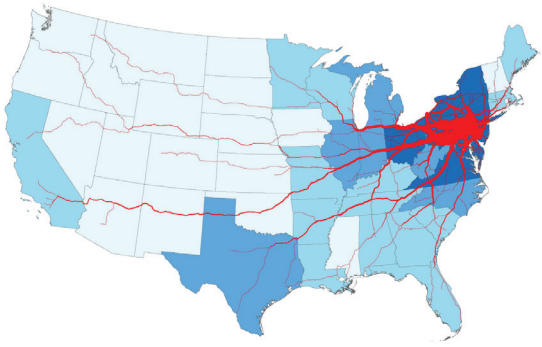
The deployment of the WZRTIS will support and enhance mobility throughout the three states, representing an unprecedented opportunity to mobilize a unique multi-state and multi-agency partnership to deploy technology advancements over a tristate region. In addition, the open platform design will ensure the system is expandable to local municipalities and other transportation agencies based on the success of deployment, with the potential to be adopted as a nationwide common platform.



Major Truck Freight Flows To, From, and Within Michigan, 2010



Major Truck Freight Flows To, From, and Within Ohio, 2010



Major Truck Freight Flows To, From, and Within Pennsylvania, 2010

Project Deployment

The WZRTIS will be developed to manage work zone processes for state-owned and toll-owned roadways that are managed by MDOT, ODOT, OTIC, PennDOT, and PTC. To ensure system requirements are appropriately developed before full-scale deployment, the agencies are proposing to complete an initial deployment on limited access highways for a 9-month period. The initial deployment will enable the agencies to validate the system Concept of Operations, System Requirements, and Systems Architecture, refine the system engineering process as necessary, and refine the data elements and output features with the developer to ensure the system is fully operational for full-scale deployment beginning in October 2019.

Each agency has determined its preferred routes for initial deployment, as shown below:

INITIAL DEPLOYMENT ROUTES	
MODOT	I-75, I-94, and I-275
ODOT	Undetermined
OTIC	System-wide (I-76, I-80, and I-90)
PennDOT	All Limited Access Routes
PTC	System-wide (I-76, I-276, I-376, Route 43, Route 66, I-476, I-576)

Table 2: Initial Deployment Routes

In Year 4 of the project performance period, in June 2020, the system will be fully rolled out to all state-owned and toll roadways under the jurisdiction of MDOT, OTIC, PennDOT, and PTC.

Transportation Systems Affected

Michigan Department of Transportation

MDOT is responsible for Michigan's 9.669-mile state highway system, encompassing 31,940 lane miles and comprised of all state (M), interstate (I), and US routes. Although the state freeway system (M, US or I routes) accounts for only 8 percent of centerline miles, it carries 53 percent of all traffic and approximately 66 percent of commercial truck traffic in Michigan. On the freeway system, MDOT oversaw 95.1 billion annual vehicle miles of travel in 2015 alone. I-75 between Detroit and Toledo, Ohio is the busiest corridor with approximately 14,400 trucks per day. I-94 between Benton Harbor and the Indiana state line typically carries 13,500 trucks per day. I-94 and I-275 are also significant freight corridors carrying more than 11,500 trucks per day.

To invest in its infrastructure and to continue modernizing the system, MDOT will invest $1.2 billion in its highway program during 2017, supporting an estimated 15,000 jobs. While demonstrating MDOT's commitment to rebuilding and expanding its transportation infrastructure, the Capital Plan will result in hundreds of long-term work zones each year across the state.

Ohio Department of Transportation

Ohio has the nation's fourth largest interstate system with over 6,800 lane miles. Three of the longest interstate routes in the country traverse through Ohio, which include I-90, I-80 and I-70. In total, Ohio maintains 21 interstate routes, which is the fifth highest total in the nation. FHWA released a report in September 2013 detailing the states most heavily traveled in the U.S., recognizing Ohio as fourth with over 31 billion interstate vehicle miles traveled in 2011. Approximately 93 percent of ODOT's time, money and labor are devoted to preserving and improving the more than 43,000 miles of roads and 14,000 bridges on the state system.

ODOT will invest $2.5 billion in its highway program during 2018. For every new $1 billion spent on transportation, an estimated 30,000 jobs are created in Ohio.

Ohio Turnpike and Infrastructure Commission

As a critical freight corridor and a transportation asset for smart mobility, the Ohio Turnpike features six lanes of well-maintained, fiber-optic equipped roadway that extends 241 miles across Ohio. Built from 1949 to 1955, the modern, limited-access highway offers one of the safest and most efficient routes for motorists to reach east/west destinations along the northern corridor of Ohio, serving as a primary connection between Chicago and Pittsburgh. The Ohio Turnpike is designated as Interstate Routes 76, 80 and 90.

Nearly 10 million vehicles traveled on the Ohio Turnpike during its first full year of operation in 1955. More than six decades later, that number quintupled to reach a total of 54.9 million vehicles in 2016 including 11.4 million commercial vehicles. In total, OTIC generated $288.4 million in 2016 toll revenues and continues its focus on customer value, motorist safety, and maintenance.

In 2016, OTIC programmed a $143.5 million capital budget, representing the largest capital improvement program for OTIC in 15 years. Resources continue to be programmed for infrastructure improvements, such as base pavement replacement, bridge rehabilitation, and repairs and resurfacing.

Pennsylvania Department of Transportation

With an operating budget of more than $8 billion, PennDOT oversees approximately 120,000 miles of state and local roadways, 31,000 brides, and public transportation, airports, rail, ports and waterways. Its state-owned roadways encompass 39,770 miles with a daily vehicle miles traveled of 208 million.The Keystone State is a critical gateway for passenger and freight traffic traveling to and from the mid-West and the Northeast portion of the U.S.

With the passage of a comprehensive transportation spending package by the PA General Assembly in 2013, PennDOT has nearly doubled its capital outlays in recent years when compared to 2013. In 2017, PennDOT is on pace to expend more than $2.5 billion in surface transportation improvements.

Pennsylvania Turnpike Commission

When it opened in 1940, the PA Turnpike paved the way for the nation's Interstate Highway System. It established the national standard for superhighway design and was constructed more than 16 years before the first U.S. interstate, becoming the model for limited-access highways.

Today, the PA Turnpike stretches 554 miles and is a critical east-west and northeast-southeast linkage for interstate commerce, extending from the Ohio border to New Jersey. Along the Mainline, the Turnpike is one of only two interstate highways that transverse the Appalachian Mountain terrains in western Pennsylvania. The PA Turnpike also features five extensions, providing access to the suburbs of Pittsburgh in southwest Pennsylvania, Philadelphia in southeast Pennsylvania, and Scranton in northeast Pennsylvania.

The PTC serves 200 million travelers each year and manages more than $1 billion in annual toll revenue, of which approximately 43 percent is generated by commercial vehicles. Toll revenue is invested back into the PTC's aggressive Capital Plan, which continues to add capacity and improve the condition of the roadway. In January 2016, the PTC completed the 116th mile of total reconstruction as part of an on-going rebuilding campaign and continued deployment of ITS infrastructure. In 2017, the capital plan was $675.9 million and in 2018, the proposed capital plan is $569.3 million with 90 percent allocated to highway projects.

ROAD / TRAFFIC

	MDOT	ODOT	OTIC	PennDOT	PTC	TOTAL
Miles of Roadway (agency maintained)	9,669	19,229	241	39,756	554	69,449
Miles of Lanes (agency maintained)	31,940	49,419	1,395	88,309	2,800	173,863
Annual Vehicle Mles Traveled (millions)(statewide)	143,800.00	117,828.87	3,037.65	100,945.31	6,504.00	362,574.18
Toll Revenue (annual)	$0	$0	$288,439,000	$0	$1,031,620,000	$1,320,059,000

Table 3: Overview of Smart Belt Coalition's Roadways

4. Need for the Project

Gaps in Traveler Information and Base for V2I Applications

Due to the temporary nature of work zones, the connected/automated vehicle industry and third party traveler information partners (e.g., WAZE, HERE, INRIX, and Sirius/XM) have indicated that obtaining reliable data in active work zones is difficult. This represents a large gap in the functionality needed to support connected vehicle applications and highly automated vehicles, as well as a gap in existing traveler information systems. The navigation tools motorists use today are not consistently fed with real-time, accurate work zone data and results in poor motorist situational awareness, congestion, and work zone crashes. Work zones change on a daily or even hourly basis, and it's crucial for these changes to be reflected in user apps in real-time to ensure safe mobility.

An article published by Wire in 2017 is precisely accurate in describing the national need for this project, identifying three underlying work zone challenges that present a roadblock for continued advances in highly automated vehicles that this project will address.

Issue 1. Inconsistent Work Zone Design and Signage. The first issue for connected and automated vehicle technology in work zones is inconsistent signage, markings, and other work zone demarcations. In today's transportation sector, a maintenance work zone can look dramatically different in Pennsylvania when compared to Michigan, Ohio, or any of the other states across the nation. As the article describes, work zones are dynamic and site-specific, and have presented real challenges with V2I and V2V technology.

Issue 2. Lack of State DOT Data Entry and Standardization. The Wired article states, "Self-driving car companies hoping to avoid active construction sites are [challenged] from the get-go, because the vast majority of states don't bother with databases detailing what work is happening where. Construction companies are usually given the latitude to start and stop work when they feel like it, and they don't always follow standards for setting up markers to warn drivers in advance."

States across the nation, including Michigan, Ohio and Pennsylvania, use manual processes to coordinate work zones or use database systems with inconsistent input and output data feed formats. The result is static data feeds that often do not occur in real time, and are not easily shareable with other entities or systems. Other challenges with these manual processes include the lack of statewide restrictions that limit the times of the day when construction crews are permitted to work on the road.

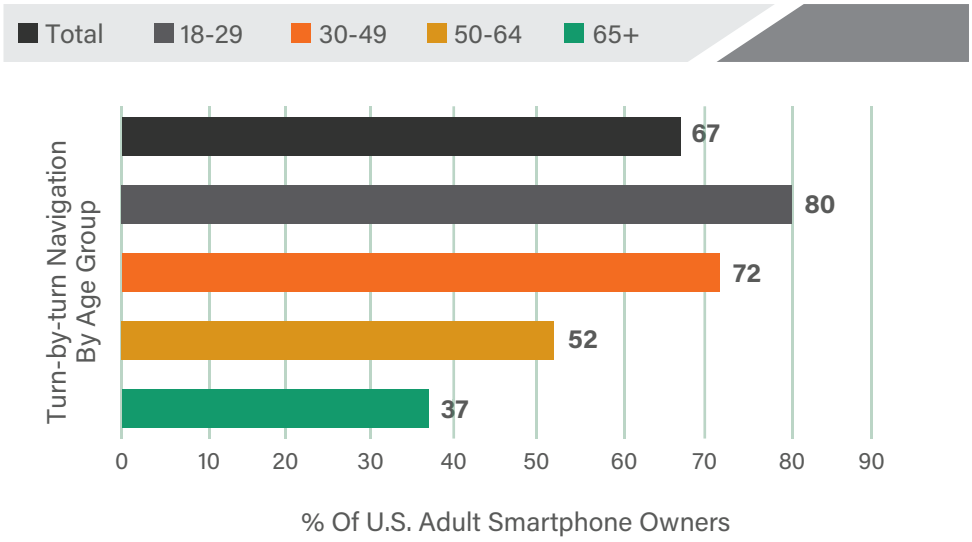
Issue 3. Traveler Information Provided for Work Zones. As an extension of issues #1 and #2, traveler information providers are not receiving the precise, real-time data needed to promote situational awareness for motorists. As an intermediate solution to work zone safety before full deployment of autonomous vehicles, equipping travelers with accurate travel information through their mobile devices will have a profound impact on congestion and safety. Today, however, accurate real-time work zone data is largely not available to providers, is not shared commonly across existing applications, and the data elements that are available are not consistent across transportation agencies.

While connected and automated vehicle market penetration is still developing, current navigation systems used by up to 67 percent of travelers aged 64 or younger with smart phones will experience immediate benefits from the deployment of this innovative technology.[1]

Work Zone Safety and System Mobility

With the authorization of over $305 billion in transportation funding through the FAST Act, transportation agencies across the nation have ramped up capital spending plans to maintain a state of good repair of their infrastructure. The increase in funding for surface transportation projects corresponds with an increase in construction work zones each year across the nation. These work zones contribute to congestion, delays, detours, changing travel patterns, and lower posted speeds, among other factors, that take drivers off-guard and create travel hazards.

% OF U.S. ADULT SMARTPHONE OWNERS WHO USE PHONE FOR NAVIGATION



Based on FHWA statistics, there were 669 fatalities from crashes in work zones in 2014, or 1.8 work zone fatalities per day. This represents an 8 percent increase from work zone fatalities that occurred in 2012 and a 13 percent increase from work zone fatalities that occurred in 2013. In addition to fatalities, an estimated 47,758 injuries occurred in work zone crashes during 2013, or approximately 131 work zone injuries every day. More than 20,000 workers are also injured in construction work zones annually, many of which are directly attributed to traveling traffic. In addition to the direct impacts of fatalities and injuries, work zone construction activities and crashes result in non-reoccurring congestion and delays which result in significant user-delay costs.

NATIONAL WORK ZONE STATISTICS

- There were 47,758 injuries in work zones in 2013, or one work zone injury every 11 minutes.
- Each year, 20,000 workers are injured in work zones
- In 2014, there were 607 fatal motor vehicle crashes in work zones, causing 669 fatalities.
- In 2014, there were 119 construction worker fatalities

Source: FHWA

Technological advancements in the form of connected and automated vehicles promise to drastically reduce the negative impact of work zones by providing timely alerts and warnings to drivers, reducing speeds and conflicts within work zones, and promoting the overall safety of drivers and workers within the zones. The basis to realizing this future is being able to provide accurate and precise work zone information to drivers and vehicle systems. The WZRTIS provides a foundation to support the further development of V2I and connected/automated systems and applications, while having an immediate impact for vehicles and drivers.

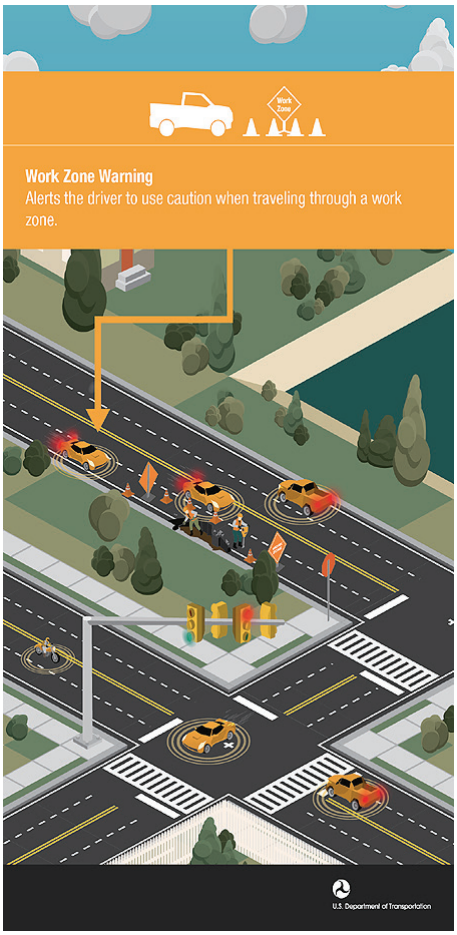
[1] http://www.pewresearch.org/fact-tank/2015/04/14/smartphone-essential-travel-guide/

Existing Work Zone Processes

To provide further clarification of how a standardized WZRTIS will revolutionize existing work zone processes, an overview of each agencies' processes is provided in a Concept of Operations summary, attached and labeled "ConOps." Today, the largely manual processes, protocols, and data elements are not standardized and are not efficient. Developing a system to reliably document active work zones and resolve potential mobility conflicts will modernize internal agency processes, provide consumable data for third parties, and enable automakers to update their vehicle navigation systems to continue the pursuit of V2I.

Developing a system to reliably document active work zones and resolve potential mobility conflicts will modernize internal agency processes, provide consumable data for third parties, and enable automakers to update their vehicle navigation systems to continue the pursuit of V2I.

MDOT. MDOT enters work zone and lane closure information into the internally developed Lane Closures and Restrictions (LCAR) system, which populates an extensible mark-up language (XML) data feed ultimately provided to partners that have data sharing agreements with MDOT (including HERE, WAZE, Sirius/XM, and others). Updates to the XML data feeds occur at a maximum 4-hour frequency, which is inadequate to capture frequently changing lane closure systems. Construction staff also do not provide real-time lane closure updates to the traffic operations staff for input into the LCAR system.



ODOT: All construction and maintenance work, except in the case of emergency, are required to use ODOT's online Permitted Lane Closure Schedule. This is a web based tool that helps identify which hours of the day lane closures are permitted and which lane closures violate the policy requiring additional analysis. Construction data and updates for each district are issued weekly and are entered manually by the Statewide Traffic Management Center (TMC), located in Columbus. TMC staff is responsible for posting traveler information to OHGO, ODOT's real-time traveler information application. An XML feed of OHGO's data is available to the public; however, ODOT does not currently have agreements with other traveler information providers.

OTIC. Contractors and maintenance crews performing work on the Ohio Turnpike are required to fill out and submit an internally developed Lane Closure Request (LCR) form prior to a closure. Currently, the entire approval process is accomplished using an Excel spreadsheet that is printed as a PDF and emailed to multiple agency staff. Information made available to the public is manually entered into various systems, including the Commission's website, Facebook page, Twitter, Customer Connection (newsletter), local press releases, and monitors at Turnpike's Service Plazas. In the future, OTIC plans to have work zones posted to WAZE and ODOT's OHGO app.

PennDOT. PennDOT operates a Road Condition Reporting System (RCRS) which serves as a data feed to PA511 (PA's traveler information application and website) and third parties. Although the RCRS is capable of early entry of planned work zones, construction crews typically do not provide information ahead of time. PennDOT maintenance crews maintain Excel spreadsheets for work schedules which are not incorporated into RCRS. This is a significant gap, particularly as it relates to detour mapping. In addition, this system is only used on state roadways, and is not available for partner agencies.

PTC. Lane closures are emailed to the Operations Center which are manually entered into the Emergency Notification System (ENS), which then posts the closure to the PTC's online travel conditions map, TRIP Talk, PA511, and WAZE. Similar to PennDOT, the PTC TOC Duty Officers often spend significant time entering lane closure information into ENS when their time would be better spent actively managing roadway operations. The PTC recognizes the gaps in the receipt of accurate information and verification of setup/tear down of work zones. Additionally, a work zone conflict red flag tool, developed by the PTC, does not check for conflicts in real time; therefore, advanced entry into ENS is required.

5-6. Detailed Project Description and Deployment

Project Overview

The project scope of work includes the development and deployment of an application to manage the work zone lane reservation process and eliminate work zone conflicts, reimagine and recreate the transmission of work zone data to third parties, and to set the foundation for V2I applications. In total, the WZRTIS is estimated to cost $7,877,000 and includes three project phases for completing systems engineering, software development, deployment, and evaluation activities.

PROJECT BUDGET

Phase	Activity	FY18	FY19	FY20	FY21	TOTAL
Project Mgmt	0.0 Program Management	$71,250	$90,000	$77,500	$71,250	$310,000
Phase 1	1.0 Systems Engineering Planning	$720,000	$	$	$	$720,000
	1.0 Initial System Procurement	$	$320,000	$	$	$320,000
Phase 2	2.0 System Development and Initial Deployment	$	$2,307,000	$597,300	$	$2,905,000
Phase 3	3.0 Individual Agency Integration	$	$	$2,200,000	$	$2,200,000
	3.0 System Evaluation	$	$170,000	$782,500	$469,500	$1,422,000
Totals		$791,250	$2,887,700	$3,657,300	$540,750	$7,877,000

Table 4: Project Budget

Phase 1 – Planning and Systems Engineering Documentation

During Phase 1 of the project, the Smart Belt Coalition will develop the Concept of Operations, System Requirements, and System Architecture documentation components of the systems engineering process. This process will carefully take into account the various ITS and IT systems of the participating agencies.

As proposed, the WZRTIS will be developed as a front-end application interface with back-end systems and application support being provided by the selected vendor. This application will support the functionality as defined in the Systems Requirements documentation. The system will be open source, and will be able to be individually integrated into the existing systems of the five transportation agencies of the Coalition (in Phase 3 of the project), with scalability to accommodate future integration with local and state transportation agencies. The systems engineering process is intended to result in a standard data feed format where work zone and lane closure information will be provided back to the procured vendor for inclusion in the overall system.

A summary Concept of Operations completed internally by the Smart Belt Coalition is attached and labeled "ConOps." This document is preliminary in nature and is intended to be an initial outline of System Requirements and operational scenarios; the document will be updated, expanded, and refined as part of the systems engineering process for this project.

During development of System Requirements, the Coalition members will identify potential opportunities to phase in deployment of individual components of the system, while adhering to the overall deployment schedule. The System Requirements will also carefully consider the overall ITS and IT infrastructure of each participating agency to ensure successful integration into each agency's systems and processes.

Upon completion of Phase 1, a Request for Proposals (RFP) will be fully prepared and advertised. Phase 1 will also include the evaluation of RFP responses, the selection of a vendor, and the procurement of the system. In total, Phase 1 is estimated to cost $1,040,000.

Procurement Process

The Coalition anticipates the use of a previously-procured firm for Phase 1 (firm to be determined). Each of the five agencies have competitively-procured firms under ITS open-end contracts that include work scopes for the development of Concept of Operations, System Requirements, and RFP documents.

The Smart Belt Coalition will issue the RFP to design, initially deploy, and test the system. As the lead agency, the PTC will issue the procurement; however, all five agencies will advertise the procurement to generate more competitive proposals. The procurement process will adhere to Pennsylvania's state laws and regulations, and will generally follow the PTC's standard procurement process. Staff from the five Coalition member agencies and affiliate academic partners will be included in the process as part of the technical evaluation team. Prior to issuing the RFP, the technical evaluation team will be established and will develop selection criteria as well as agreement upon the details of the procurement process.

Phase 2 – Initial Deployment and Evaluation

Under Phase 2, the development and initial deployment of the WZRTIS application and system interface will occur. As part of the development process in this phase, the WZRTIS will be deployed along initial corridors for each participating agency to evaluate against the System Architecture, System Requirements, and the Concept of Operations, and to implement changes as required.

MODOT	I-75, I-94, and I-275
ODOT	Undetermined
OTIC	System-wide (I-76, I-80, and I-90)
PennDOT	All Limited Access Routes
PTC	System-wide (I-76, I-276, I-376, Route 43, Route 66, I-476, I-576)

Table 5: Initial Deployment Routes

Upon completion of Phase 2 in December 2019, the system will be ready for full-scale deployment and integration with the Coalition agencies. In total, Phase 2 is estimated to cost $2,905,000.

Phase 3 – Full Deployment, Evaluation, and Integration

During Phase 3, each agency will take the results of the initial deployment of the system to integrate the final application into their own back-end systems. While each agency will have the flexibility to deploy and implement the WZRTIS on select roadways, the Coalition's objective is to roll out full deployment to all state-owned and toll roadways to truly benefit from a standardized, ITS solution for work zone management. A primary system requirement will be that, regardless of individual agency integration methods, a commonly-formatted data feed will be provided back to the overall WZRTIS.

At this time, ODOT is not proposing to integrate the WZRTIS into its existing systems as part of Phase 3 of this proposed ATCMTD initiative. However, the overall WZRTIS will be functional and available for all three states as part of this project.

Upon completion of integration, the Coalition is proposing a 12-month system performance and impact evaluation period to be completed with assistance from The Ohio State University (OSU). Developing the evaluation criteria will begin in 2019, and actual evaluation will occur after integration. In total, Phase 3 is estimated to cost $3,622,000.

Procurement Process

The Coalition agencies will integrate the system into their own existing agency systems and processes. This may entail engaging additional contractors or vendors that are unique to each agency; in this instance, the procurement processes will follow that specific agency's procurement processes and any state-specific contracting laws and/or regulations. These integration costs are included in the grant request.

Future System Requirements

As envisioned, the system will be constructed with the intent to add additional functionality over time to accommodate advances in automated and connected vehicle technology and data analytics.

Predictive Data Analytics: As technology progresses, predicative data analytic capabilities will be added to the system to enhance functionality.

Basis for V2I Applications: Work zone-related V2I applications, such as lane reduction warning or reduced speed warning applications, require accurate and precise work zone location information. It is intended that this system could be further developed to support V2I applications.

System enhancement beyond the identified phases of this grant application will be undertaken by the Coalition, outside of the grant award.

Open System

Unique to this project, the Coalition is proposing that the system be an open platform, meaning once designed with full scalability, the Coalition welcomes local and state transportation agencies and tollway authorities to integrate the system. Initial scalability is anticipated to include local municipalities and partners which may include utility companies and contractors. The open platform concept will also allow for adding functionality to the system in the future.

An ATCMTD grant is critical to help offset system engineering and deployment costs to ensure the system has the capability to be scalable for an unlimited number of users and to be the basis to provide V2I applications in the future. When looking to the future, this grant request represents a small portion of the potential overall investment. The initial grant will allow for a base system that the five agencies, and other agencies and partners beyond the Smart Belt Coalition, can leverage.

When looking to the future – additional users and added functionality to the system – this grant request represents a small portion of the potential overall investment. The initial grant will allow for a base system that agencies and partners beyond the Smart Belt Coalition members can leverage.

Long-Term Operations and Maintenance

Post deployment, the Coalition agencies are fully committed to the long-term operation and maintenance of the system and have the internal funding, staff, and partnerships in place to effectively manage the WZRTIS. Each agency is expected to fund the operations and maintenance of their individual integrated systems separately. However, the system will be designed so that if any participating agency decides to discontinue the funding of the operations and maintenance of their portion of the system, there will be no additional costs to other participating agencies.

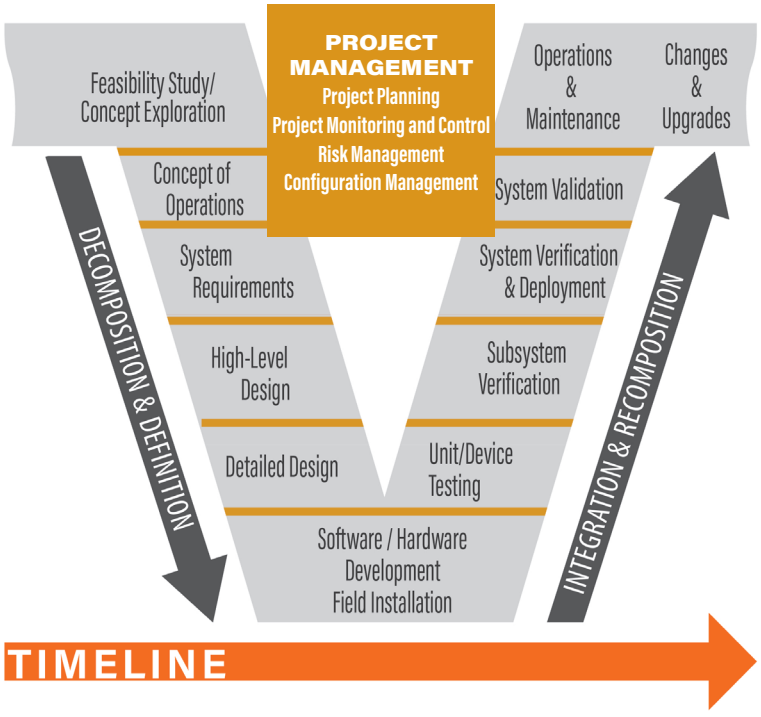
The system will be designed so that additional agencies will be allowed to integrate the system outside of the grant performance period with no costs for the Coalition members. The additional agency(ies) will be responsible for their own integration costs, as well as the operations and maintenance of their system.

7. Challenges and Risks

Project Risk Management

ITS Project Management Processes outlined in the Systems Engineering for Intelligent Transportation Systems guide book provides preferred processes for assessing project risk. Because this project is a multi-agency multi-state effort, the standard four step risk management process outlined in the Systems Engineering process will be followed:

- Risk Identification
- Risk Analysis and Prioritization
- Risk Mitigation
- Risk Monitoring



The WZRTIS is anticipated to potentially contain medium and high risk impacts due to the complexity of integrating a front-end system with back-end systems that are individually maintained by MDOT, OTIC, PennDOT, and PTC. This risk will be minimized as much as practical by following the structured systems engineering process. As an ITS project, the agencies are requiring a Systems Engineering Management Plan for the system and will adhere to FHWA's project management and control activities to support systems engineering, as outlined in the "V" Diagram. The project team will also be required to report to the Executive Management team on a regular basis across the five agencies. The Executive Management team will closely monitor and address any regulatory, legislative, or policy concerns related to the project.

Any ITS or IT project needs to ensure cybersecurity by design. Similar to the risks mentioned previously regarding the complexity of integrating a system with multiple agency systems, there will need to be consideration for cybersecurity protection for each agency. This risk will also be minimized by following the structured systems engineering process.

8-9. Quantifiable Benefits

Overview

The WZRTIS will provide quantifiable benefits in system performance, including mobility, operational efficiency, and safety. These anticipated outcomes align directly with system performance goals and objectives of the five agencies. Additionally, the identified quantifiable benefits of this project are supported by the Transportation Research Board and FHWA's Work Zone Safety and Mobility Rule (23 CFR 630 Subpart J) which encourages agencies to collect and analyze work zone data. These performance measures will help quantify how work zones directly impact drivers and highway workers and will illustrate how the WZRTIS improves overall work zone management. While most agencies select either safety or mobility to measure, the Smart Belt Coalition has selected to measure both safety and mobility.

Each respective agency has procedures and reporting mechanisms in place for monitoring and evaluating system performance on an annual basis. As a result, performance and quantifiable benefits of the WZRTIS will be monitored on a state level and reported in the respective performance evaluations that occur each year.

However, for purposes of the Smart Belt Coalition and evaluating the investment from a larger viewpoint, OSU has agreed to help structure an independent performance measurement system that will be utilized by the Coalition for purposes of performance management as it relates to the ongoing operation and management of the system. The existing annual performance reporting activities undertaken by the agencies will help streamline data collection efforts.

Upon completion of systems engineering in Phase 1, OSU will work with the five agencies to develop a performance logic model that outlines inputs, outputs, and short-term, intermediate, and long-term outcomes. OSU's involvement will ensure data collected and analyzed meets the joint needs of the agencies and research communities, and provides a sound data collection and measurement methodology to quantify system performance and safety, mobility, and environmental benefits.

A framework for the logic model is summarized in Table 6 and directly advances US DOT's goals as outlined in the Notice of Funding Opportunity. In addition, the Smart Belt Coalition has outlined quantifiable projections for safety, system performance, economic savings, and agency efficiency in the preceding section.

PROJECT BUDGET

Focus Area	Goal	ID	Objective and Performance Mearsures	ATCMTD Program Goals
SAFETY (Motorist and Employee)	To enhance safety, mobility, economic competitiveness and overall quality of life of the partner states through strategic deployment of innovative technology	1.1	**Reduce the number of crashes.** ◢ # of reportable crashes/Million Vehicle Miles Traveled	◢ Reduction in the number and severity of traffic crashes and an increase in driver, passenger, and pedestrian safety; ◢ Demonstration, qualification, and evaluation of the impact of these advanced technologies, strategies, and applications towards improved safety, efficiency, and sustainable movement of people and goods;
		1.2	**Reduce the number of crashes.** ◢ Rate of Reportable Crashes per Million Vehicle Miles Traveled ◢ # of fatalities ◢ Rate of Fatalities per 100-Million Vehicle Miles Traveled ◢ # of serious injuries ◢ Rate of Serious Injuries per 100-Million Vehicle Miles Traveled	
		1.3	**Reduce the number and severity of "on-the-job" injuries to maintenance and construction workers in the field.** ◢ Rate of Reportable Crashes per Million Vehicle Miles Traveled ◢ # of fatalities ◢ Rate of Fatalities per 100-Million Vehicle Miles Traveled ◢ # of serious injuries ◢ Rate of Serious Injuries per 100-Million Vehicle Miles Traveled	
SYSTEM PERFORMANCE / FREIGHT / CMAQ (Mobility and Reliability)	Achieve an accessible, reliable, and uninterrupted travel highway system.	2.1	**Increase mobility and reliability in travel time.** ◢ % of Interstate System providing for Reliable Travel Times ◢ % of the Interstate System where Peak Hour Travel Times meet expectations ◢ % of the Interstate System Mileage providing for Reliable Truck Travel Times ◢ % of Interstate System Mileage Uncongested ◢ Annual Hours of Excessive Delay per Capita	◢ Delivery of environmental benefits that alleviate congestion and streamline traffic flow; ◢ Measurement and improvement of the operational performance of the applicable transportation networks; ◢ Collection, dissemination, and use of real time transportation related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services; ◢ Delivery of economic benefits by reducing delays, improving system performance and throughout, and providing for the efficient and reliable movement of people, goods, and services; ◢ Accelerated deployment of vehicle-to-vehicle, vehicle-to-infrastructure, and automated vehicle applications, and autonomous vehicles and other advanced technologies; ◢ Integration of advanced technologies into transportation system management and operations;

Table 6: Performance Measurements

Motorist Safety

Existing Conditions

Deployment of the WZRTIS is expected to improve safety in work zones by enhancing the situational awareness of motorists. Every year, there is an average of 12,000 reportable crashes that occur in work zones in Michigan, Ohio, and Pennsylvania, or an average of 32 work zone crashes that occur each day in the tristate area. These crashes have substantial safety implications for motorists and workers, and contribute to non-reoccurring congestion.

Expected Outcomes

Based on historical trend analysis and data supporting the benefits of traveler information systems, the Smart Belt Coalition is anticipating a decrease in the number of crashes and the number of crashes that include injuries and fatalities. Safety impacts should be realized across the three states once the system is fully deployed.

- **SAFETY METRIC #1.1: Reduce the number of crashes per MVMT to below the Smart Belt Coalition regional average.** The current Smart Belt Coalition regional crash rate, at 2.06 crashes per Million Vehicle Miles Traveled (MVMT), is above the Smart Belt Coalition 5-year regional crash rate of 1.96 crashes per MVMT for all roadways. Within three years of full implementation, in addition to ongoing safety initiatives per each agency's transportation improvement program, the Smart Belt Coalition is targeting a reduction in the crash rate by five percent per MVMT.
- **SAFETY METRIC #1.2: Reduce the number and severity of work zone crashes per MVMT to below the Smart Belt Coalition regional average.** The current Smart Belt Coalition regional work zone crash rate is 0.036 crashes per MVMT, which is higher than the Smart Belt Coalition 5-year regional average (0.033 crashes per MVMT). Within three years of full implementation, the Coalition is targeting a reduction in the crash rate by 10 percent per MVMT. Additionally, the current work zone fatality rate in the Smart Belt Coalition region is 0.017 fatalities per 100-MVMT. The Coalition also anticipates a 10 percent reduction per 100-MVMT. The 5-year regional average for work zone fatalities is 0.016 fatalities per 100-MVMT.

As noted in Table 5, there are additional metrics associated with each of these motorist safety measures that will be further defined in the detailed Concept of Operations.

Employee Safety

Existing Conditions

Each year on average there are over 50 worker fatalities in Smart Belt Coalition work zones. This includes at last one agency employee every year. Additionally, there are over 800 injuries in the field and almost 4,000 equipment accidents every year. This is important because these types of incidents can result in additional fatalities. On average, the Smart Belt Coalition agencies pays over $15 million in workers' compensation payments each year. By improving situational awareness and reducing congestion, this project will improve safety for work zone workers.

ANNUAL REPORTABLE WORK ZONE CRASHES (Statewide)						
	2012	2013	2014	2015	2016	AVERAGE
MDOT	4,592	4,093	4,701	4,776	4,994	4,631
ODOT	5,476	4,616	5,149	6,103	6,053	5,479
OTIC	333	248	224	320	346	294
PennDOT	1,666	1,851	1,848	1,936	2,075	1,875
PTC	204	282	214	267	327	259
SUM	**11,734**	**10,560**	**11,698**	**12,815**	**13,122**	**11,986**

Table 7: Work Zone Crashes, 2012-2016

WORK ZONE FATALITIES (Including Employees)						
	2012	2013	2014	2015	2016	AVERAGE
MDOT	15	9	21	15	18	16
ODOT	17	19	17	30	28	22
OTIC	1	2	1	3	3	2
PennDOT	21	16	24	23	16	20
PTC	1	2	3	5	4	3
SUM	**53**	**44**	**62**	**68**	**62**	**58**

Table 8: Work Zone Fatalities, 2012-2016

Expected Outcomes

- **SAFETY METRIC #1.3: Reduce the number and severity of "on-the-job" injuries to maintenance and construction workers in the field to below the Smart Belt Coalition regional average.** The way agencies define and categorize employee injuries and equipment accidents makes it difficult to distinguish between work zone related and non-work zone incidents; therefore, the target reductions were normalized. In addition to agency employee safety initiatives, it is anticipated that a reduction in employee injuries, equipment accidents, and worker compensation payments of five percent can be realized. During the most recently reported years, there were 760 employee injuries, 3,340 equipment accidents, and $10.1 million in workers' compensation payments.*

Mobility and Reliability

Existing Conditions

By improving safety in work zones and providing better coordination of work zone activities by placing restrictions on lane reservation, the WZRTIS will improve mobility across state and toll roadways in Michigan, Ohio, and Pennsylvania.

PENNSYLVANIA

Traffic congestion costs the average commuter 182 hours of delay and 86 gallons of fuel wasted every year in major urban areas. Statewide congestion is estimated to cost drivers over $3.7 billion per year in lost time and wasted fuel.

- ASCE

Expected Outcomes

- **MOBILITY METRIC #2.1: Increase Mobility and Reliability in Travel Time.** In an effort to support the regional TSMO framework, the WZRTIS will assist in maintaining reliable and consistent travel times and help reduce delay throughout the tristate area. These performance measures were published in the Federal Register on January 18, 2017 and became effective on May 20, 2017;

*Michigan's statistics were estimated at the time of the application.

therefore limited existing data exists from each agency. These measures will be further defined in the detailed Concept of Operations portion of the project. The proposed performance measures are listed below with the intended target. These may change based on the detailed Concept of Operations and the capabilities of each Smart Belt Coalition agency. It is anticipated that these measures would be reported as the Smart Belt Coalition region.

- Percent of Interstate System providing for Reliable Travel Times: Level of Travel Time Reliability (LOTTR) – Target: 80 percent
- Percent of the Interstate System where Peak Hour Travel Times meet Expectations: Peak Hour Travel Time Ratio (PHTTR) – Target: 80 percent
- Percent of the Interstate System Mileage providing for Reliable Truck Travel Times: Truck Travel Time Reliability (TTTR) – Target: 80 percent
- Percent of Interstate System Mileage Uncongested: Average Truck Speed – Target: 75 percent
- Annual Hours of Excessive Delay per Capita: Total Excessive Delay – Target: 5.0 hours\capita

WZRTIS Performance

In addition to quantifiable benefits in safety, mobility, and reliability on the roadway network there are also performance outcomes related to the WZRTIS. The WZRTIS is being developed and deployed, in addition to providing traveler information, to address:

- Inconsistent Work Zone Design and Signage
- Lack of State DOT/Toll Agency Data Entry and Standardization

The specific WZRTIS measures will be further defined in the detailed Concept of Operations through the development of the System Requirements. It is anticipated that the performance measures could include the following, at a minimum:

- Percent of work zones that are captured in the system prior to the activity
- Percent of work zone conflicts identified
- Amount of time between active work zone and traveler alert
- Amount of time between complete work zone and traveler alert
- Accuracy of form data being passed to traveler information systems

10. Visions, Goals, and Objectives

The vision, goals, and objectives of the Smart Belt Coalition are concisely and accurately stated in the executed LOU and are directly applicable to the WZRTIS.

Vision and Mission

1. The Coalition's vision is to be an innovation network that fosters the advancement of connected and automated vehicles while growing the knowledge and economy.
2. The Coalition's mission is to create a mechanism for transportation agencies, academic institutions and others to collaborate on connected and automated vehicle initiatives.

Goals

1. The Coalition will foster collaboration involving research, testing, policy, standards development, deployments, outreach, and funding pursuits in the area of connected and automated vehicle technology as well as other innovations in the transportation industry.
2. The ultimate goal of the Coalition is the strategic deployment of innovative technology that enhances safety, mobility, economic competitiveness and overall quality of life.
3. The role of the five agencies as infrastructure owners is to guide research, deployment, and policy development that support their respective missions. The role of the seven affiliate members as academic institutions and research centers is to jointly work with the agencies to identify and develop potential research topics in connected and automated vehicles as well as other emerging technologies.

Objective

At a foundational level, the development and deployment of the WZRTIS is the first and primary Coalition action step taken to achieve its goal of deploying connected and automated vehicle technology to enhance safety, mobility, economic competitiveness, and overall quality of life. It duly represents the first project initiative of the Coalition and the project that the five agencies have prioritized as the most critical not only for Michigan, Ohio, and Pennsylvania, but as national significant.

11. Partnerships

Smart Belt Coalition

The WZRTIS project is proposed as a multi-state effort to improve work zone coordination and to standardized work zone data elements for traveler information systems. The project is being completed by the Smart Belt Coalition member agencies, a partnership between MDOT, ODOT, OTIC, PennDOT, and PTC.

Under the structure of the Coalition, the WZRTIS will be implemented in close coordination with several paramount partnerships that excel in innovation through private resources and private research. While the five transportation agencies are funding 100 percent of the match requirement, primary project partners include the Coalition's seven research and academic affiliate members. It is anticipated that in-kind contributions, above and beyond the 50 percent match requirement, will be provided to support two key areas of the project.

- Performance Measurement
- Quality Assurance with System Engineering

With the LOU executed and regular communications and quarterly meetings, the mechanism to engage the research and academic partners is already established and underway. In many ways, these members are equally invested in the success of the project and recognize the value the data will have for university research projects related to autonomous and connected vehicle.

The Coalition also recognizes the US DOT as a project partner, and welcomes support throughout project implementation to foster a collaborative approach to the project, particularly to ensure the system is an open, portable software that can be scalable to other transportation agencies across the nation.

Existing Data Sharing Agreements

In addition to the partnership of the agency members and research affiliates, the project will also leverage existing private industry partners that have active data sharing agreements with the five agencies. These industry partners – for example, WAZE/Google, HERE, Sirius/XM, INRIX, Clear Channel, and others – receive data feeds from the five agencies to support travel information applications. This project will dramatically improve the agencies' ability to provide standardized, precise work zone location data in real time, strengthen the partners' products, and pave the foundation for continued advances in V2I applications.

Letters of Support

This project enjoys a broad range of state, local, and private support across Michigan, Ohio, and Pennsylvania. Letters of support are attached and labeled "LOS".

12. Leveraging Existing Investments

As transportation infrastructure owners and operators, the agencies of the Smart Belt Coalition have undertaken a significant time and investment effort into managing and improving the operations of work zones under their jurisdiction. These efforts will be leveraged as part of this effort.

MDOT has invested in its traveler information system, staffed traffic operations centers, a lane closure reporting system, connected vehicle DSRC infrastructure, and a back-end processing system (Data Use Analysis and Processing System) used by connected vehicle work zone applications. MDOT has formal data sharing agreements with several third-party traffic information service providers, such as (but not limited to) WAZE, HERE, and Sirius/XM. MDOT's integration of the WZRTIS will leverage all of these systems and capabilities.

ODOT has invested in its online Permitted Lane Closure Schedule. This is a web based tool that helps identify which hours of the day lane closures are permitted and which lane closures violate the policy requiring additional analysis. ODOT also has a real-time traveler information application, which will benefit from this project.

The **OTIC** uses an internally-developed database to assist with the management of lane closure requests, and shares the information with WAZE and Ohio's traveler information website. These resources will be leveraged throughout the development and integration of the WZRTIS at the OTIC.

PennDOT has developed a Road Condition Reporting System for use in reporting lane closures due to weather, incidents, or work zones. Maintenance, traffic management center staff, or county staff can input closure information into the system. The system provides a data feed to a traveler information system, and several traffic information provider partners. PennDOT will leverage their existing assets when integrating the WZRTIS.

The **PTC** has invested in an infrastructure-based traveler information system, including a traffic operations center, a traveler information website, and field devices, in order to provide lane closure information to the public. An internally-developed, electronically-communicated form is used to assist in the tracking and dissemination of lane closure information. The integrated WZRTIS at the PTC will incorporate these assets.

Additional information on leveraging existing investments is provided in the attached Concept of Operations Summary, labeled "ConOps".

13. Project Schedule

A detailed project schedule is attached and labeled "Schedule". Based on a grant award announcement in September 2017, the Smart Belt Coalition is scheduled to commence project activities in October 2017. In total, the schedule includes three phases and a 45-month completion schedule.

Prior to the start of Phase 1, the project team will begin grant administration, including the finalization of financial agreements between all five participating agencies. Public outreach for all five agencies will also commence, and will continue throughout the length of the project.

Phase 1 of the project focuses on the Systems Engineering process and includes the selection of the vendor for the WZRTIS application. Phase 1 will start with a finalization of the Concept of Operations for the application, the development of System Requirements, and development of the System's Architecture. Phase 1 will be completed with a RFP process and the selection of the vendor to develop and implement the WZRTIS application.

Phase 2 of the project will commence in April 2019. Under this phase, the development and initial deployment of the WZRTIS application and system interface will occur. As part of the development process in this phase, the WZRTIS will be deployed along initial corridors for each participating agency to evaluate against System Requirements and the Concept of Operation. Upon completion of Phase 2 in December 2019, the system will be ready for full-scale deployment and integration with the Coalition agencies.

In **Phase 3**, the system will be integrated individually with MDOT, OTIC, PennDOT, and PTC's existing applications, processes, and back-end systems. This effort will be managed individually by the respective agencies, although the WZRTIS project management staff will be fully engaged to support implementation efforts and troubleshooting. ODOT is not proposing to integrate the WZRTIS into any existing systems as part of Phase 3 of this proposed ATCMTD initiative. However, the overall WZRTIS will be functional and available for all three states as part of this project.

In addition to integration, Phase 3 will also include the development of a systems evaluation program to definitively measure the impact of the deployment and to continue evaluation against the project's Concept of Operations and System Requirements. Post integration, the project includes a 12-month period to complete system evaluation, which will include the development of a system performance measurement plan (related to safety, mobility, and traffic operations) as well as an evaluation of software performance.

The five agencies are eager to commence the project and stand ready to initiate project kick-off pending the success of this WZRTIS.

14. US DOT ITS Initiatives

The WZRTIS project will directly leverage federal ITS initiatives as outlined in the US DOT ITS Strategic Plan 2015-2019 (Plan). The Plan prioritizes investments in connected vehicle implementation and advancing automation to improve roadway safety, enhance mobility, limit environmental impacts, promote innovation, and support transportation connectivity.

The WZRTIS will be designed to serve as a foundation for future V2I applications, such as lane reduction warning or reduced speed warnings. Current pilot deployments of these applications indicate that the location of work zones is a critical input element for application functionality; this system will serve as the basis for providing accurate work zone locations. In addition, deployment will improve safety and reduce roadway congestion (and reduce greenhouse gas emissions) by enhancing data sharing connectivity with travelers.

With the support of US DOT through an ATCMTD grant, the deployment of the WZRTIS project will have a geographic reach spanning a tristate region, offering a direct impact on millions of travelers. The built-in scalability of the system holds the promise of advancing integration for additional end users.

The US DOT ITS Strategic Plan also emphasizes the need for established and effective partnerships to accelerate deployment efforts. The Smart Belt Coalition embodies a forwarded-thinking, innovative focused multi-agency partnership. With the support of US DOT through an ATCMTD grant, the deployment of the WZRTIS project will have a geographic reach spanning a tristate region, offering a direct impact on millions of travelers. The built-in scalability of the system holds the promise of advancing integration for additional end users.

1. Staffing Description

Organizational Structure

This project will use a project management team concept, which has proven successful with other multi-agency projects. With this concept, the project management team will include a lead agency with an overall project manager, and a second agency fulfilling the technical management roles of the initiative. With a complex technical project that includes the coordination of five separate transportation agencies, it is critical for project success that there are separate resources dedicated to managing the administration and progress of the grant and project, and managing the detailed technical aspects of the project.

To support the project, each agency will assign an agency lead to participate in document development

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2. Primary Point of Contact

The primary point of contact for this ATCMTD grant application is Amber Reimnitz, Senior Traffic Operations Project Manager at the PTC. Questions and request for additional information may be directed to:

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Senior Traffic Operations Project Manager
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Middletown, PA 17057
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E-mail: areimnit@paturnpike.com

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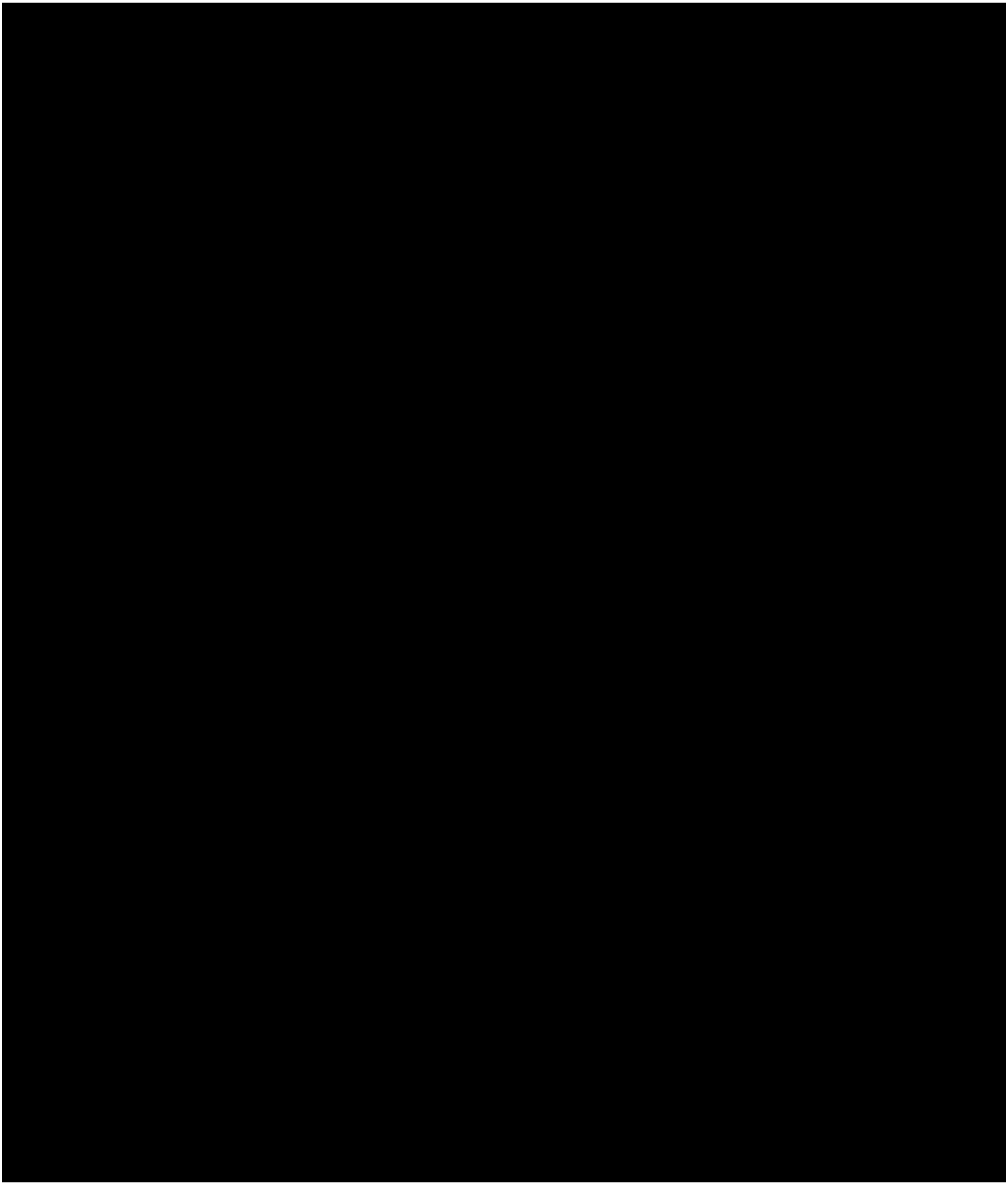

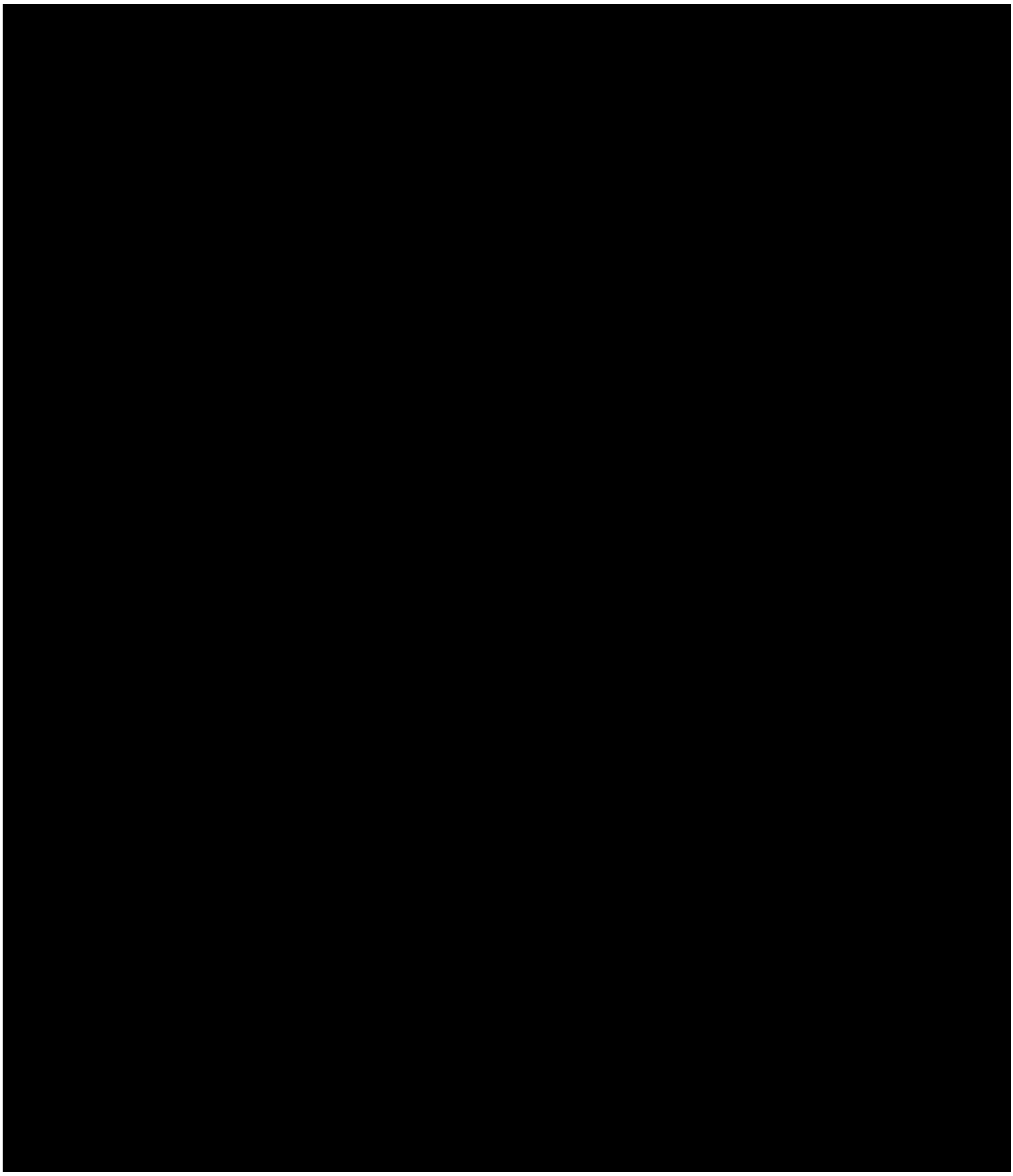

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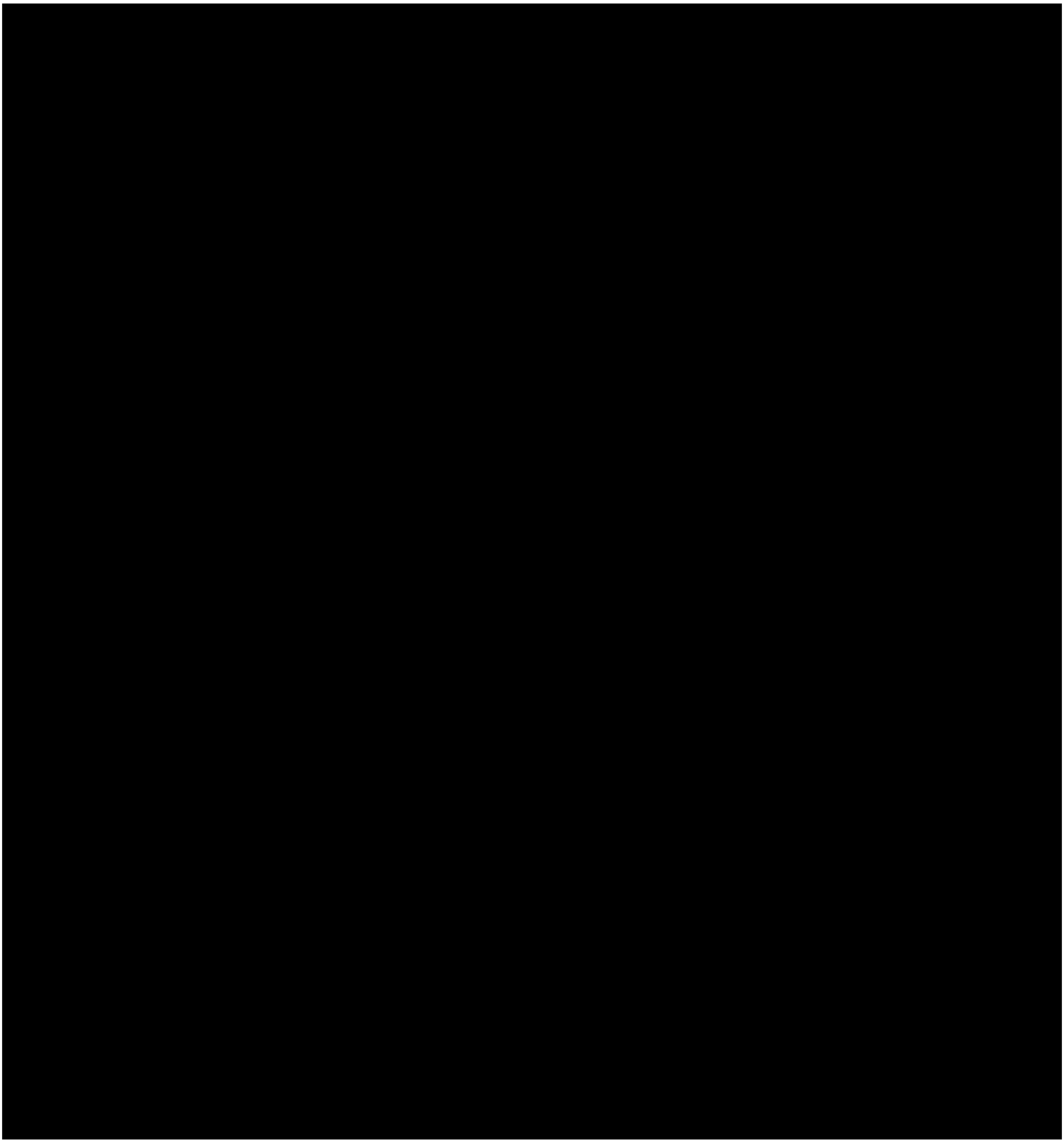

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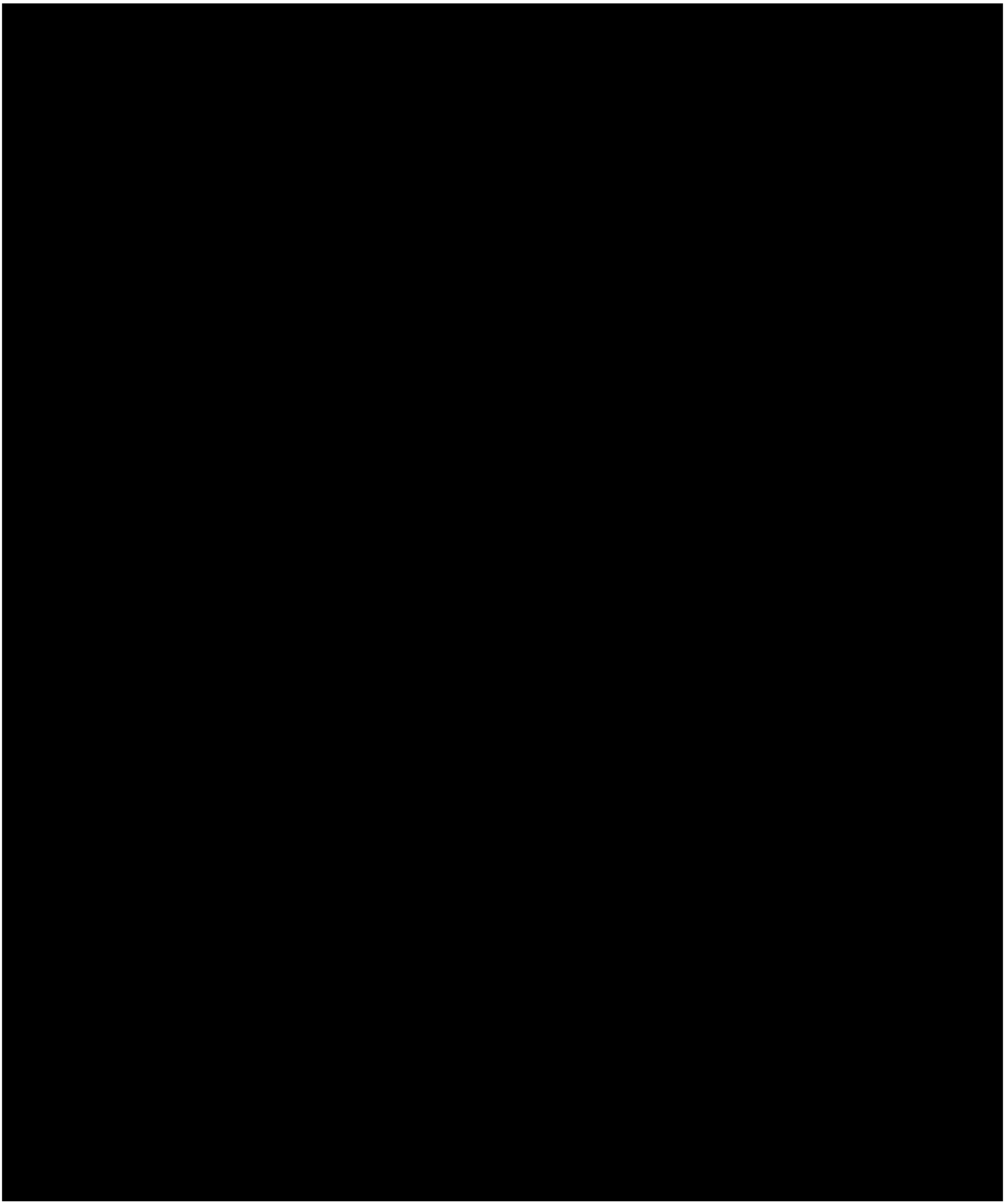

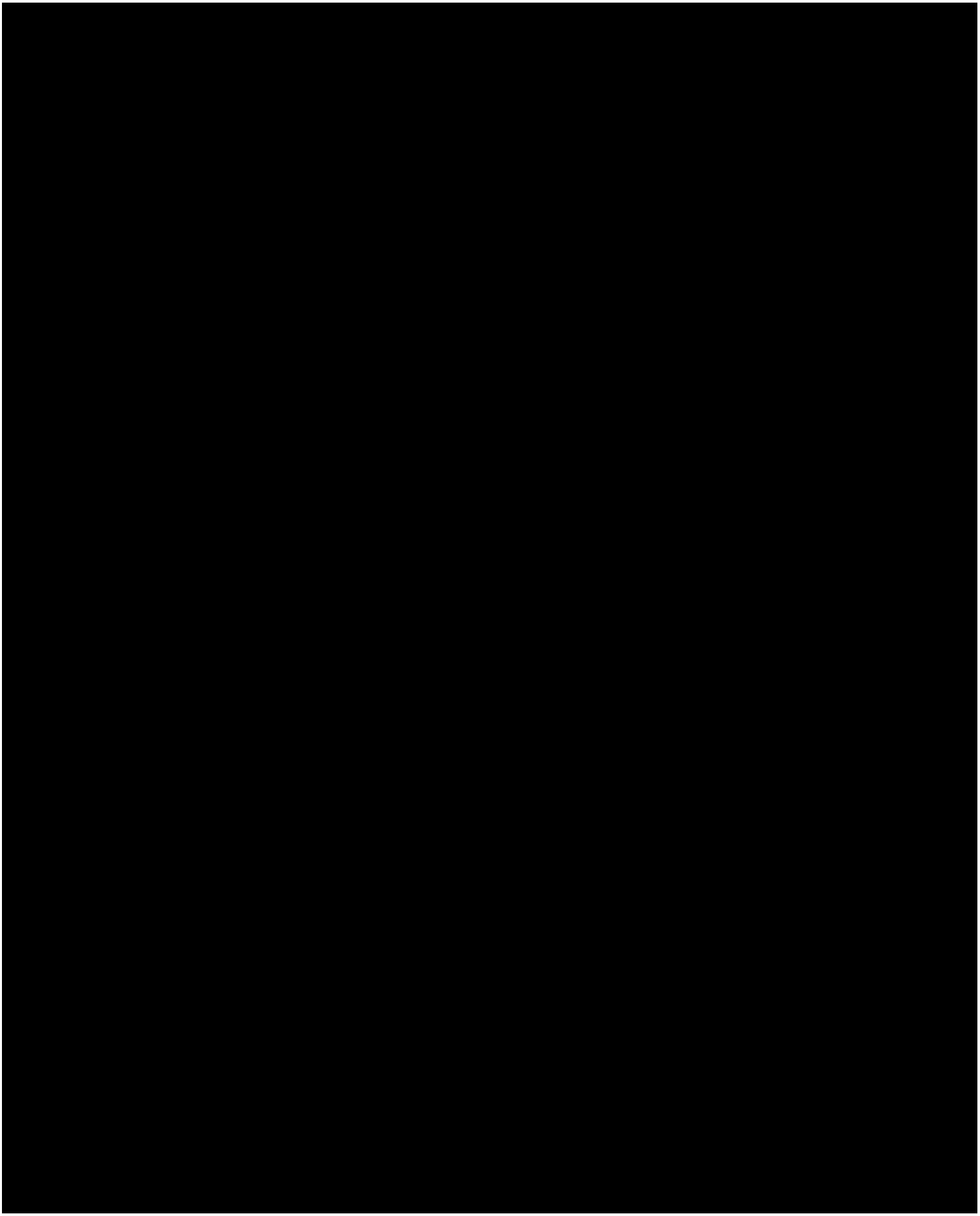

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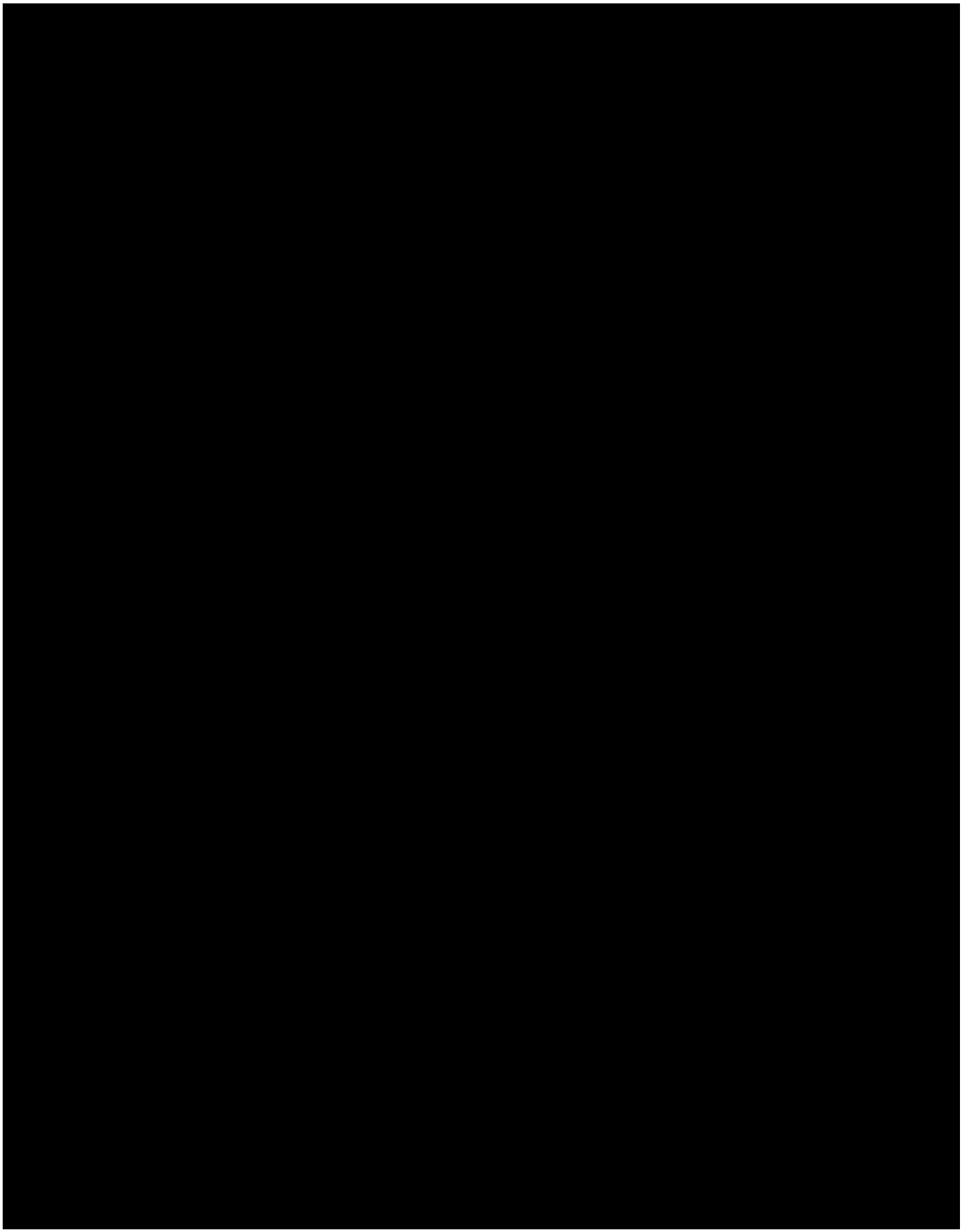

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