1.0 Project Description:

Civil Express is a student team leading the highway development world today, focusing on transportation, structural, construction, environmental, and water resources engineering within the Civil Engineering Field.

Civil Express proposes to deliver a reconfiguration of a 4,500 feet stretch of I-475 located in Flint, MI. The site will begin at the merge on and off E Stewart Avenue interchange lanes and extend to the E Pierson Road overpass. The intersection between E Stewart Avenue and N Dort Highway experiences high levels of traffic congestion and head-on collisions, suggesting that an installation of a roundabout would be ideal for this area. Another addition that the team proposes includes installing a community park space with a parking area and updated crosswalks on E Pierson Road near Horton Avenue. This project will also encompass the analysis, selection, and design of the 1475 overpass over N Dort Highway connecting to E Stewart Avenue.

This current I-475 location must be more robust and suitable for reduced community travel. By reducing lanes, I-475 will better match the overall level of service of the area and will lower future maintenance costs. With I-69 currently under construction, this project will maintain Michigan infrastructure improvements and create more job opportunities. A preliminary assessment of the infrastructure suggests that this stretch of I-475 has not seen any major reconstruction for at least a few decades.

Project Site Location

The proposed project site is located along the I-475 Highway corridor from E Stewart Avenue to E Pierson Road. This area encompasses the Flint City Ordinances within Genesee County. Some notable structures and geographical features surrounding the proposed project site include American Spiral Weld, Bay Logistics Indoor Storage, Lockhart Chemical Company, City of Flint Water Plant, E Stewart Avenue McDonald's, E Stewart Avenue BP Gas Station, and The Flint River.

Project Site Components

This project will encompass the analysis, selection, and design of the 1-475 overpass over N Dort Highway connecting to E Stewart Avenue. The proposed project site is located along the I-475 Highway corridor from E Stewart Avenue to E Pierson Road. This area encompasses the Flint City Ordinances within Genesee County.

Civil Express has determined the project location and significant components throughout the proposal. The project's location is along I-475 in Flint, MI, and the critical components span from the I-475 intersection of E Stewart Avenue to E Pierson Road. Through site evaluations, conditions exposed the structural deteriorating North Dort Highway Overpass, the poor current

pavement conditions, and the high-risk crash intersection. In addition to the structural requirements, I-475 is a dividing area between residential homes and the industrial-zoned area. The Flint community needs more gathering areas and connections between city-wide bike trails, promoting the idea of the park installation.

Project Scope of Work

This project's scope of work requires the expertise of all members of Civil Express. The construction lead will develop the estimates, schedules, and project management plans. In addition, Civil Express's transportation lead will complete all traffic studies to help design the most efficient and safe designs. The structural lead will calculate all current and future loads when redesigning the North Dort Highway Overpass. Lastly, the environmental and water resources lead will complete all stormwater calculations to design the most efficient storm sewer systems and ensure that the current water central infrastructure and environments do not affect the highway reconfiguration.

Civil Express is proud to implement sustainability practices into every project component. The team will strive to reuse construction materials, reducing costs for waste and materials. In addition, the roundabout and park will both provide Low Impact Development to the environment.

2.0 Collaboration of Faculty, Students, and Licensed Professional Engineers:

Civil Express has worked closely with faculty and licensed professional engineers to deliver this project professionally. Civil Express University faculty members were involved by meeting weekly to address progress and any questions or concerns. Each faculty member assisted with a specialized sub-discipline. These sub-disciplines included construction, environmental, Water Resources, structural, and Transportation Engineering. In addition to the support of the faculty, licensed professional engineers provided feedback during significant milestone completion dates. When a major milestone arose, the invited professional engineers reviewed our new calculations and design development. Civil Express received feedback about current industry issues and addressed any questions.

The students of Civil Express were very determined to present this project to the University faculty and licensed professional engineers. Civil Express received great feedback from all. This achievement was attained by keeping all Civil Express team members motivated throughout the project. Civil Express met once a week, but this often escalated to twice a week around major milestone deliverables. In addition, Civil Express kept great organization of all documents within a shared calendar and folders. Civil Express is very pleased with the results of each team member's efforts and is excited to continue sharing this project.

3.0 Sustainability and Environmental Considerations

Civil Express will implement the 3 R's initiative: Reduce, Recycle, and Reuse to alleviate the environmental effect this project might have. The structure redesigns within this project will follow the cost and material-effective design. Reducing the number of materials benefits the environment and the project's total cost. Civil Express intends to recycle several materials from the original structures.

Material Reuse

Old concrete can be recycled by breaking, removing, and crushing it from existing locations. Then it can be used to create new reusable materials. Civil Express intends to recycle existing steel into new steel products. Steel recycling consists of shredding and melting it to create new metal sheets. Even though steel's conditions may influence its recycling value, every steel can be recycled. If the rust is melted, it will re-form once the metal cools. Therefore, the recycling process also includes purification, where elements such as carbon can be added to bond with the oxygen and free the iron. This process also removes other impurities like ink or dried paint. Evaluation of the subgrade should occur before using the existing subgrade. With existing highway segments following Michigan Department of Transportation standards, the aggregate base should follow consistent standards to today's specifications. Reusing the aggregate base would be ideal for crossing the reconstructed highway segment into any soil.

Installation of Sustainable Practices

The Low Impact Development (LID) technology for a roundabout uses the center circle to plant vegetation and create an engineered medium from natural soils/plants that are the most permeable portion. Then, moving outwards from the center, there is a sod slope that further encourages natural infiltration. Last, the roundabout uses permeable pavers, a less porous surface that allows minor infiltration of excess run-off, to direct the remaining surface flow to storm sewers. Civil Express could use a similar design in the proposed N Dort Highway and E Stewart Avenue roundabout to provide a safer intersection and better drainage on these roadways.

The construction of the community park will have minimal impact on the surrounding nature. Extraction of trees in this area would need to be removed for the overall community park, but Civil Express does not intend to demolish surrounding trees in the area. The park would also use long-lasting materials, easy-to-maintain plants and landscaping, organic mulch, and recycling bins for park patrons.

The environmental lead’s focuses for phases one and two of this project are noise pollution, air pollution, sedimentation control, and surface water pollution. One section of the highway, the proposed roundabout at E Stewart Avenue and N Dort Highway next to the Flint water treatment plant, will have a water main that must be considered due to the construction potentially

interfering with the current infrastructure. The environmental lead will also manage the noise pollution by creating a sound-level map of the site and the design of natural sound barriers. Being within 500 feet of the Flint River, the impact of run-off from the site could be detrimental to the surrounding areas of Flint; therefore, the environmental lead will monitor stormwater run-off from the surface during construction to reduce this impact. Installation of silt and sedimentation traps will prevent contamination of storm and sanitary sewers. The Environmental Engineer will be responsible for addressing any environmental impact the project will cause and will implement designs to make it environmentally friendly and up to code.

Environmental Considerations

The environmental lead's focuses for phases one and two of this project are air pollution, sedimentation control, and surface water pollution. One section of the highway, the proposed roundabout at E Stewart Avenue and N Dort Highway next to the Flint water treatment plant, will have a water main that must be considered due to the construction potentially interfering with the current infrastructure. Being within 500 feet of the Flint River, the impact of run-off from the site could be detrimental to the surrounding areas of Flint; therefore, the environmental lead will monitor stormwater run-off from the surface during construction to reduce this impact. Installation of silt and sedimentation traps will prevent contamination of storm and sanitary sewers.

Air Pollution

The air pollution for this project will be generated from the construction processes such as excavation of materials, removal of pavement, and transportation of materials. In order to limit the soil and/or silica dust pollution water should be used to keep dry aggregates and existing pavements moist to weigh down the dust particles and limit air contamination. Additionally, materials such as existing aggregate bases and/or recycled concrete/bit millings will be used for the site in order to limit the air pollution from trucks transporting construction materials.

Surface Water Pollution

The quality of water must be managed during the construction and after the construction is completed. As previously discussed, Civil Express has considered Vortech chambers for the quality of water after the construction is completed. During the construction, however, the best way to manage surface water pollution is to limit the pollutants present. In order to successfully limit pollution, litter and trash could be put into trash receptacles provided on site. To limit sediments in runoff, soils and sources of dust on site should be kept moist in order to weigh the particles down and limit the chances of surface runoff transporting these solids during storm events. Additionally, sediment traps need to be installed on storm sewer catch basins to prevent the excess sediments that may end up in stormwater runoff despite wetting sources of dust and aggregates on site. Oils, greases, concrete waste, etc should be placed into designated waste areas so these pollutants are contained and can be transported from the site after operations are completed.

4.0 Cultural and Social Impact

Addressing how a project will impact a city's society and culture is vital to determining how beneficial a project will be. According to the Oxford Dictionary, "cultural" is "relating to a society's ideas, customs, and social behavior". The cultural identity for this I-475 Reconstruction Project is the City of Flint and its citizens. This project will impact the culture of Flint because it will help emphasize good social behaviors and activities. The development of the park space will encourage community unity and development. This, in turn, further develops the culture. This location will enable citizens to explore the city they call home and unite individuals to support Flint. This park will additionally aid in improving the overall health of the citizens living in the area. Encouraging and advertising the many bike trails throughout Flint by including a bike station at the park space will generate more users of the bike trails. By developing a location for citizens to gather, Civil Express is working to improve the ideas, customs, and social behavior of Flint. As a result, Civil Express intends that communication between citizens and their health will improve.

The dynamic order of team leads will allow Civil Express to impact the community in the positive reconstruction and development of the area surrounding I-475. This project's overall impact on the City of Flint is an increase of community unity. Community unity comes from the increase in connections people have with each other. Civil Express has defined the installation of the park space as an area of encouraging citizen activity with more space for general community events and as a connection point between vehicle, pedestrian, and public bus transportation avenues. Civil Express wants to deliver a solution for a community that best fits the needs and wants of the community. The Flint City area deserves to be proud of the growth in their community, and this project will help make more connections between some of the widely used bike trails. Focusing on the reconstruction of dangerous roadway conditions applies to the overall safety and the community by enhancing the quality of life for those in the area.

5.0 Protection of Health, Safety, and Welfare of the Public:

Overall public safety is the most significant focus for Civil Express in developing this project. The highest safety consideration includes improving road conditions and alterations to the Dort Highway and Stewart Avenue Intersection. There will be an increase in safety when the highway is used compared to the existing conditions of large potholes. The roundabout installation will vastly decrease the delay time of the intersection and should help reduce the number of vehicular crashes that have been previously observed. In one instance, many of the vehicular accidents involving sideswiping and turning should be significantly reduced with the roundabout installation. Also, less need for electric traffic signals for the roundabout will assist with using the intersection with the high power outages observed in this part of Flint. One aspect that Civil Express will continue to analyze is the movement of the bike trail and sidewalk that initially crossed the intersection. This trail has been moved approximately 150 feet south, connecting to

the bike trail by the Flint River on Dort Highway. This alteration should better connect with more bike trails in the area, but Civil Express will need to ensure that sidewalk movement will still be feasible for pedestrian use.

The community park space will greatly help to increase the community's overall welfare. The park space will allow for rest and connection between bike trails and vehicular traffic. The park space will also encompass the sidewalk restoration for pedestrian walking and on the bike trail itself, allowing for safer use.

The project would be very beneficial to the residents of Genesee County and the city of Flint. The highway reconstruction would give a better quality pavement and a safer surface to drive on since the quality of the existing road could be better. A newly reconstructed highway would also provide a better aesthetic to the highway since the current conditions are deplorable.

6.0 Multi-Discipline and Allied Profession Participation:

Each team's capstone design course presentations allowed for open communication between those teams, faculty, and licensed professional engineers. Approximately twenty-four (24) P.E. Licensed Professionals and three (3) Non-P.E Licensed Professionals attended the presentations or other deliverable submissions. Technical break-out sessions allowed Civil Express team members to consult with industry partners and licensed engineers who could provide more input based on each sub-discipline. The licensed and non-licensed engineers provided technical feedback that allowed for specific, constructive criticism of Civil Express design features, calculations, and general applications.

All advice from industry partners was considered for this project, but not all recommendations or applications were implemented with further consultation with professionals in applying such changes. Civil Express team members consulted professionals on these applications individually, with team meetings becoming a collaborative space for discussing these applications and solutions.

Not only did the industry leaders provide valuable recommendations or applications for the project, but they also consulted Civil Express team members on the values inherited by becoming a licensed engineer. Discussions with appropriate timelines for the F.E. Exam and P.E. licensing exam preparation became prevalent based on the applications of each sub-disciplinary resource. Civil Express team members plan to take the F.E. Exam by the completion of 2023, with all members also planning avenues for experience needed for the P.E. Licensing Exam.

7.0 Knowledge or Skills Gained:

The students within the Civil Express team gained several valuable skills in addition to the invaluable knowledge gained throughout the project. Within the two semesters, team members gained skills in effectively communicating a design and its components to varying audiences. The team had the opportunity to present the project to industry professionals, faculty members, and high school students. Civil Express had to format the material presented to each of these groups' experience and expectations to ensure the design was communicated clearly and effectively. Professionalism was also a critical skill the group gained from this project. As discussed, the team had to present on several occasions to varying audiences formally. The students had to prepare for these presentations by researching the correct design standards, processes, and information to confidently and competently provide the relevant information and answer the audience's questions with the accurate and adequate responses.

All student team members have current or prior work experiences within the civil engineering field, with many participating in research opportunities with faculty. Although highly beneficial, these work and research opportunities have not been as diverse and widespread as this project is through the capstone design course. The collaboration through a multitude of sub-discipline focuses allowed Civil Express to work effectively together in reaching the necessary deliverables to make this project efficient, cost-beneficial, and concentrate on the needs of the Flint City area.

The students also gained skills in industry software programs provided by the faculty and Professional Engineers. Many of these programs are expected to be used within the field, with several applications to the field's projects. Programs referenced or utilized within this project include, but are not limited to:

- Adobe Acrobat
- Adobe Illustrator
- AutoDesk 3DS MAX
- AutoDeskAutoCAD
- AutoDesk Revit
- Bluebeam
- EPA SWW
- Google Earth Pro
- Mathcad 15
- MDOT TDMS
- Microsoft Excel
- Microsoft Projects
- Microsoft Teams
- Microsoft Word
- Midas Civil 3D
- Rodel
- StormCAD
- Trimble Sketchup
- Visual Studio
- Zoom Application

Approximately sixty (60) total national, state, county, local, AASHTO, MDOT codes, Maintenance Work Zone Traffic Control Guidelines, Federal Highway Administration codes, standards, and ordinances were consulted in the engineering decisions made by Civil Express.

The capstone design course experience was an effective theory and practice collaboration. Civil Express Team Members had to decipher real-life problems with the technical ability to bring solutions. With this experience, student members would have seen the immense collaboration within the Civil Engineering Field.