DEPARTMENT OF TRANSPORTATION

Unmanned Aircraft Systems (UAS) - Metro District Bridge Inspection Implementation

Barritt Lovelace, Principal Investigator
Collins Engineers, Inc.

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Research Project
Final Report 2021-13

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Drones for bridge inspection research has been completed by MnDOT in multiple phases since 2015. As of summer, 2017, Phase III of this research began using the SenseFly Albris and the Flyability Elios, a collision-tolerant drone more suited to confined spaces such as box girders, culverts, or areas that are difficult to access. Due to the success of this research, MnDOT Metro District purchased the Elios drone to supplement bridge inspection access where space is confined and optimal lane closures are prohibited, which has been an on-going issue in the District due to traffic volumes. This project implements drone inspection for the metro bridge inventory and other similar representative structures by creating an inspection plan that identifies bridges best suited for drone use, what parameters govern drone use in bridge inspection, and how unmanned aircraft systems (UAS) can be integrated into standard inspection operations. The project explores relevant technology, including reality modeling software, drone hardware, artificial intelligence, and autonomous flights. This project also delivers the UAS Safety and Operation Manual specific to the Metro District.</td></tr>
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UNMANNED AIRCRAFT SYSTEMS (UAS) – METRO DISTRICT BRIDGE INSPECTION IMPLEMENTATION

FINAL REPORT

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LIST OF ABBREVIATIONS

3D	Three-Dimensional
UAS	Unmanned Aircraft System
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
BSIPM	Bridge and Structure Inspection Program Manual
CFR	Code of Federal Regulations
CoRE	Commonly Recognized Structural Elements
DSLR	Digital Single-Lens Reflex
FAA	Federal Aviation Administration
FC	Fracture Critical
FCM	Fracture Critical Member
FHWA	Federal Highway Administration
FPV	First Person View
GCP	Ground Control Point
GPS	Global Positioning System
HDR	High Dynamic Range
IRT	Infrared Thermography
JSON	JavaScript Object Notation
LOS	Line of Sight
LRFD	Load Resistance Factor Design
MBE	AASHTO Manual for Bridge Evaluation
MNDOT	Minnesota Department of Transportation
MT	Magnetic Particle Testing
MUTCD	Manual of Uniform Traffic Control Devices

MTP	Manual Tie Point
NBI	National Bridge Inventory
NBIS	National Bridge Inspection Standards
NCHRP	National Cooperative Highway Research Program
NDE	Non-destructive Evaluation
NDT	Non-destructive Testing
NHI	National Highway Institute
NRHP	National Register of Historic Places
PPE	Personal Protection Equipment
QR	Quick Response (QR Codes)
SI&A	Structure Inventory and Appraisal
SIMS	Structure Information Management System
TH	Trunk Highway
TL	Team Leader
UBIV	Under Bridge Inspection Vehicle
UT	Ultrasonic Testing
UTG	Ultrasonic Thickness Gage

EXECUTIVE SUMMARY

Bridges are important components of our transportation system, and maintaining these structures is critical to ensuring the safety of the traveling public. Inspection of bridges is fundamental to programming maintenance and corrective actions necessary to ensure a healthy and functioning transportation system. Bridge safety inspections are mandated by federal law and the collection of inspection data can be costly and time consuming, and inspections contain inherent risks for the bridge inspectors and the traveling public. Unmanned aircraft systems (UAS) have proven to be a low cost and low risk way to supplement bridge inspection efforts in Minnesota. Technology from both a hardware and software standpoint continues to evolve making UAS use more accessible to bridge inspectors and deliverables are increasingly more beneficial.

As part of this research project, UAS was applied to many different bridge inspections for several different purposes. The bridges ranged from small simple structures to large, river-crossing, signature bridges. The data collected was integrated into the bridge inspection reports mostly by including links in the report to cloud-based, web-sharing platforms.

MnDOT has recently purchased a fleet of drones in addition to the Flyability Elios that is already owned by MnDOT Metro District. The purchase and use of these new drones will exponentially increase the implementation of UAS for bridge inspections within MnDOT. This implementation will benefit MnDOT by lowering inspection costs, improving quality, and improving safety for bridges inspectors and the traveling public. It will also provide an additional access tool, supplementing the use of under-bridge inspection vehicles (UBIV) and rope access.

As part of this research project, a risk based prioritized list was developed for Metro District bridges that would benefit from drone inspections based on parameters conducive to UAS use. These parameters included average-daily-traffic (ADT), feature intersected, bridge type, bridge conditions, and a record of previous successful UAS inspections.

The bridges were sorted by score, with higher scores representing bridges that are more likely to benefit from UAS inspection from both a risk and benefit standpoint. Several of the bridges on the list were inspected as part of this project and results can be found in Chapter 4 of this report. This list can be used in the future to help identify bridges that can be inspected by the Elios drone.

Several case studies are presented in this report demonstrating different applications for using UAS for bridge inspections. These efforts are included as part of this report, but all work was part of actual inspection projects. These results are incorporated into the bridge inspection record. UAS technology has developed to the point where field work and post processing has become routine. The efficiencies gained from technological advances and from experience are significant. For example, the Blatnik Bridge located in Duluth was part of the Phase II Research Project, and one week was spent in the field with a team of 6 people who covered only a small portion of the main spans. In this phase of research, a team of two people completed the entire UAS inspection in less than one day and gathered data for the entirety of the main spans.

An *Unmanned Aircraft Systems (UAS) Safety and Operation Manual* was developed as part of this project. The intent of the manual was to provide a risk-based approach in evaluating when to use UAS for bridge inspections based on hardware and software that MnDOT uses for bridge inspections. Also included were best practices to guide UAS operators and help minimize the risk of incidents, which could cause damage to the drone or property or cause injuries. The manual was based on several years of experience with drone use within MnDOT and while risks cannot be completely eliminated, following the manual will minimize risks significantly.

UAS have proven to be a low-cost and low-risk way to supplement bridge inspection efforts in Minnesota. Technology for both hardware and software is evolving making UAS more accessible to bridge inspectors and making the deliverables more beneficial. Artificial intelligence, mixed reality, holograms, autonomous flights, computer vision, and reality modeling are no longer technologies that our industry looks forward to but are available now and have been used by Collins Engineers and MnDOT. This report demonstrates how the technologies work for bridge inspections, giving examples and use cases that demonstrate the benefits.

CHAPTER 1: INTRODUCTION

1.1 RESEARCH BACKGROUND AND OBJECTIVES

Bridges are important components of our transportation system, and maintaining these structures is critical to ensuring the safety of the traveling public and protecting these public investments. Inspection of bridge structures is fundamental to determining the maintenance schedule and corrective actions necessary to establish a healthy and functioning transportation system. The National Bridge Inspection Standards (NBIS) set minimum requirements for bridge inspections including inspector qualifications, inspection intervals and inspection procedures. The NBIS was implemented into federal law in 1968. As of November 2019, the NBIS was in the process of Proposed Rule Changes which would significantly change the NBIS requirements. Proposed changes include an expanded extent of inspection, stating "Any portion of the bridge not visible using standard access methods must be assessed via another method". Phases I, II and III of this research project presents the cost effectiveness and increased safety of inspection through the use of Unmanned Aircraft Systems (UAS). For the purpose of this report, the terms UAS and drone are used interchangeably. Combined with the rapid development of UAS technology and regulation, UAS implementation has been proven to be an effective, efficient, and safe tool for visual access to components otherwise not visible using standard methods.

The first two phases of the project, Phase I and II, were carried out in the summers of 2015 and 2016, respectively. The primary scope of these phases was to evaluate UAS technology as a tool for bridge inspection. The third phase, Phase III, was carried out in the summer of 2018 and focused on the application of UASs in the inspection of various bridge types and configurations. As this research has progressed, the focus has shifted from if UASs can be used, to where and how can UASs be used. The resulting studies were published by MnDOT's Research Services. These phases outline the definition of UAS hardware, processing software, FAA regulation, and various methods of implementation.

Due to the success of the research thus far, MnDOT Metro District purchased the Elios UAS to supplement bridge inspection access where space is confined and optimal lane closures are prohibited, which has been an on-going issue in the District due to traffic volumes. In addition, as of spring 2020 the MnDOT Bridge Office is in the process of developing a statewide UAS program for structure inspection. The program will provide necessary means and methods to both state and local agencies to inspect bridge components using state issued UASs.

Phase IV of the research effort implements drone inspection to the Metro bridge inventory by creating an inspection plan that would identify situations best suited for UAS use, what parameters govern UAS use in bridge inspection, and how UAS could be integrated into standard inspection operations. This project also develops a UAS Safety and Operation Manual specific to bridge inspections and is applicable to the MnDOT Bridge Office Statewide UAS Program.

1.1.1 Phase I – Unmanned Aerial Vehicle Bridge Inspection Demonstration Project

1.1.1.1 Scope

This project phase, completed in 2015, demonstrated the use of UAS for bridge inspection, evaluated the technology's effectiveness, and addressed the safety implications for routine bridge inspections.

1.1.1.2 Execution

Investigators identified four bridges in Minnesota that represented a variety of bridge types and sizes: an 80-foot local bridge in Chisago County, a medium-sized concrete arch bridge in Oronoco, a large steel truss bridge in Morrison County, and a 2,682-foot long railroad bridge near Stillwater that rises 185 feet above the St. Croix River.

Researchers then reviewed current and proposed FAA rules and regulations pertaining to UAS use for bridge inspection and worked with the MnDOT Office of Aeronautics to acquire necessary authorization for inspections. After reviewing UAS options, investigators selected the Aeyron Skyranger UAS and contracted a drone pilot to help conduct inspections of each selected bridge. Researchers compared UAS results to recent bridge inspection records. The Skyranger drone is shown in the photos below.

Figure 1-1 Overall Photographs of Four Bridges Selected for Phase I UAS Inspection (Shown clockwise from upper right, Arcola Bridge, Morrison County Pedestrian Truss, Chisago County Bridge, Oronoco Concrete Arch)

1.1.1.3 Findings

The Aeyron Skyranger UAS provided high-quality detail on the two large bridges, and its zoom lens was effective with the medium-sized concrete arch bridge, allowing viewing and assessment of many bridge element conditions. Smaller bridges with limited clearance underneath proved challenging for the UAS due to loss of GPS signal under concrete decks. As the UAS lost GPS signal, it would then return automatically to its take-off point, or home base. Another barrier of this specific UAS was that the camera mounted underneath the drone could not look up.

Before UAS field work began on any of the selected bridges, detailed investigation and safety plans were prepared for each structure. Site-specific plans addressed safety, potential hazards and how to mitigate them, current FAA rules, and inspection methods. Based on analysis of field work, inspection results, regulations for UAS use, and emerging inspection specific UAS technology, researchers concluded the following:

- UASs can be used for bridge inspection with little risk to inspectors and the public and can reduce safety risks that inspectors currently face. They should be considered a tool in routine inspection and for situations not requiring hands-on inspection, testing, sounding, or cleaning.

They also suit pre-inspection surveys and can identify rope anchor points and other safety needs before hands-on inspection begins.

- UASs provide inspection detail that effectively replicates detail learned through use of snoopers without traffic control at significantly lower costs in equipment and traffic control needs.
- UASs provide both infrared and 3D modeling detail of bridges, effectively identify concrete delamination, gather topographic mapping detail, and efficiently map riverbank conditions upstream and downstream from the bridge sites.
- Inspectors should select a UAS capable of pointing cameras upward and operating without GPS.

1.1.2 Phase II – Unmanned Aircraft System Bridge Inspection Demonstration Project

1.1.2.1 Scope

This project phase aimed to expand the demonstration to different structure types and size utilizing an inspection specific UAS to further assess the ability of a UAS to be a widespread and accepted inspection tool. Technology and federal regulation were further evaluated to refine the inspection method.

1.1.2.2 Execution

This research phase built on Phase I findings and looked at additional Minnesota bridges including a large steel through arch, a steel high truss, a large corrugated steel culvert, and a movable steel truss. Now having acquired a new inspection specific Sensefly Albris shown in the images below, the performance was compared to the industry standards of hands-on inspections. Each method was evaluated by focusing on the differences in access methods, data collection, and the ability of the UAS to be used as a tool for interim and special inspections. FAA rules were explored to determine how practical they were regarding UAS bridge inspection applications.

Before UAS field work began on any of the selected bridges, detailed investigation and safety plans were prepared for each structure. Site-specific plans addressed safety, potential hazards and how to mitigate them, current FAA rules, and inspection methods.

Several imaging devices were tested including still image, video and infrared cameras. After the data collection was completed, data was processed through the computer software Pix4D.

Figure 1-2 Overall Photograph of Four Bridges Selected for Phase II UAS Inspection

1.1.2.3 Findings

Based on the observations in the field from the Phase I and Phase II studies, the following conclusions were made:

- UASs can be used safely and effectively on bridges in challenging conditions.
- UASs can be used in GPS-deprived environments, but piloting skills become more important.
- UASs are more suitable as a tool for inspection of bridges with elements that are difficult to access.
- UASs themselves cannot perform inspections independently and should be used as a tool for qualified and experienced bridge inspectors to view and assess bridge element conditions in accordance with the National Bridge Inspection Standards (NBIS).
- UASs used in conjunction with thermal sensors can be an effective way to detect concrete delaminations and can be done without closing the bridge to traffic.
- The ability to direct cameras 90 degrees upward and the ability to fly without a GPS signal are important features when using this technology as an inspection tool.
- In some types of inspections, UASs have the capability to be used in lieu of an under-bridge inspection vehicle and would provide significant savings. These savings would come in the form

of reduced or eliminated traffic control and reduced use of under bridge inspection vehicles and lifts.

- Safety risks associated with traffic control, working at heights and/or confined spaces, and near traffic could be reduced with the use of UASs.
- UASs can provide important pre-inspection information for planning large-scale inspections. Information such as clearances, rope access anchor points, and general conditions can easily be established with UASs and would aid in the planning of an inspection.
- Utilizing UASs in conjunction with photogrammetry software such as Pix4D can provide a 3D model and point cloud of a bridge and bridge site that is valuable in determining unknown dimensions and provides a high-quality inspection report deliverable.

1.1.3 Phase III – Improving the Quality of Bridge Inspection using Unmanned Aircraft Systems (UAS)

1.1.3.1 Scope

This research phase expanded the implementation of inspection specific UASs to include a larger number of bridge types, sizes, and configurations. Specific consideration was made to use UASs in place of and in addition to standard inspection procedures and access methods. UASs enhanced deliverables were incorporated into inspection reports alongside standard deliverables to facilitate in vetting the work product of UASs.

1.1.3.2 Execution

This research phase implemented UAS technology on 39 bridges including a wide range of bridge size, type, and location. The results of this research effort demonstrated that UAS technology and processing software are effective tools to improve the quality of bridge inspections in addition to improving safety and reducing costs. By applying the technology to a large number of bridges, we were able to understand where the different technologies work the best and were able to determine cost savings and efficiencies gained. Traditional access and reporting methods will continue to be utilized even as UAS technology improves, but they have proven to be another effective tool. This phase identified opportunities to improve the quality of MnDOT inspections, improve safety, and reduce costs.

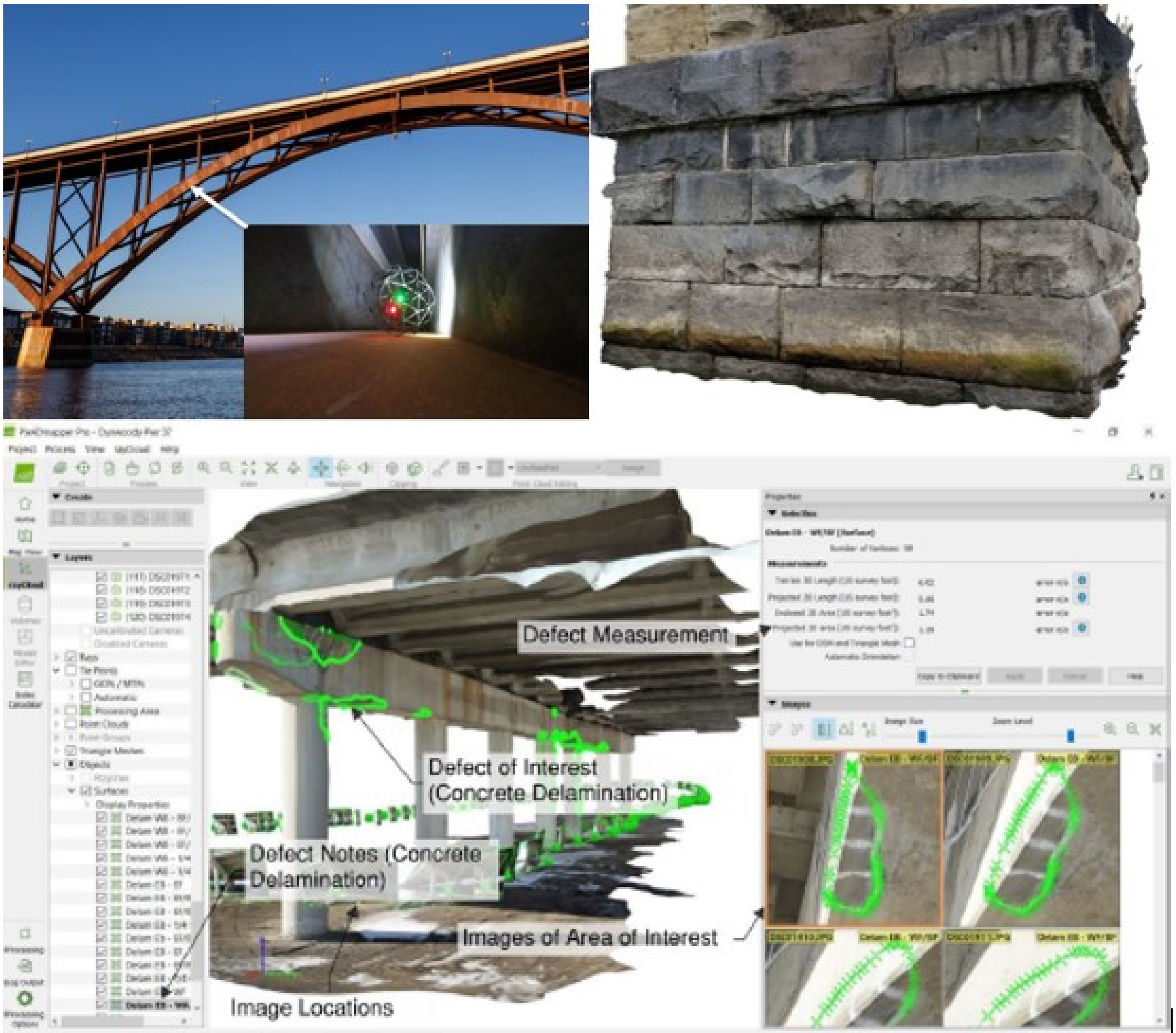


Figure 1-3 Phase III UAS Enhanced Deliverables

1.1.3.3 Findings

Phase III findings further concluded that the use of UASs as a bridge inspection tool was a valuable and reliable asset for every bridge inspector to have access to. As identified in Phases I and II, UASs play a specific role in bridge inspection. They should not be considered a replacement for required hands on inspection techniques but, rather to be a supplemental tool for inspectors to use in situations where access or environmental factors would otherwise make standard techniques too risky or not possible. Below are some key findings from Phase III:

- FAA and MnDOT Office of Aeronautics regulations continue to change. However, they are becoming increasingly more accepting of the technology and its uses. Through the creation of Part 107, LAANC, and other regulation aids, acquiring permission to fly is now a relatively simple process and possible in a significant portion of statewide airspace. Part 107 is the set of regulations the FAA has in place for commercial drone operators and LAANC is the system in place to exchange data on to provide Low Altitude and Notification Capabilities.

- UAS hardware selection is important to consider with respect to what the desired outcome and deliverable are, along with the operating environment. Commercial grade UASs remain to be the most reliable, safe, and productive UASs on the market but can carry an expensive price tag. Lower cost consumer UASs are adequate for many jobs, however, they are not a substitute for commercial UASs currently.
- UAS hardware is continuing to adapt to its consumer needs to meet the requirements of FAA and professional grade deliverables. Technology advancements such as sense and avoid technology, automated flight capabilities in GPS denied environments, and improved battery life are significant advancements which could make UAS for bridge inspection even more attractive.
- Data captured during UAS missions can be in many different forms and yield different results. Prior to flying, a pilot or engineer should have an idea of the final desired deliverable and ensure data gathered is optimized to create this product.
- Drone use should be considered as part of a risk-based approach to bridge inspection where safety, cost and quality improvements can be realized.
- Safety risks can be reduced for both inspectors and the public. Much of the focus has been on the safety of flying a UAS, but the emphasis should be on reducing the risk of the overall inspection.
- A collision-tolerant UAS should be considered for confined space inspections where access and safety can be improved without a reduction in inspection quality.
- Collision-tolerant UASs should be considered for the inspection of multi-beam bridges, especially when a hands-on inspection is cost prohibitive.
- Field conditions, including weather, and bridge type, location and configurations vary widely. While image quality is important, the focus should be on the inspector's qualifications, experience and ability to determine if the quality of the data is enough to determine with certainty the structural condition of a bridge.
- Many of the same improved deliverable benefits can be realized by utilizing terrestrial photography. Models of specific bridge components such as piers can be generated in combination with a UAS or by themselves.
- UAS technology has advanced rapidly but their benefits are not being realized due to underutilization. Bridge owners should consider their use when considering inspection quality, cost savings and safety.
- Reality modeling of bridges is revolutionizing the documentation and communication of inspection results. Bridge owners should take advantage of this technology to improve their bridge inspection programs.

CHAPTER 2: TECHNOLOGY REVIEW

UAS technology continues to progress as manufacturers innovate and strive to meet the needs of both commercial and recreational users. The transportation industry is benefiting from these innovations, and the use of UASs for bridge inspections has become more beneficial and accessible in the last five years. Improved sensors, lower costs, better reliability, and collision avoidance are some of the improvements that reduce risks and increase benefits for bridge inspections. The ability to create 3D models provides an additional benefit to inspections.

Recreational use has created a large demand for mid-grade consumer UAS platforms, such as the Parrot Anafi and DJI Mavic. These mid-grade UAS platforms are incorporating technologies which benefit the inspection specific UAS field; however, they still are not a suitable replacement for commercial UAS platforms for many applications. Image quality continues to be a significant differentiator when selecting a drone for bridge inspections.

There is a wide range of uses and deliverables when using UASs for bridge inspection. The selection of an inspection UAS should be based on the environment and goal of the inspection. For example, using a UAS with collision tolerant frames or active obstacle avoidance is a good choice for situations where close-up imagery is required and in locations that are heavily congested or confined. A consumer grade UAS is generally the best selection for overall terrain modeling, imaging of components that are not easily accessible from the ground but have a clear line-of-sight from a higher elevation, or in 3D model generation of smaller structures (generally under 150 feet long). Commercial UAS platforms are used in the same situations as a consumer grade UAS but, can be used on much larger and more complex bridges that have spans in excess of 4,000 feet. A commercial UAS is also preferred when image quality is important, which is often the case in bridge inspections. Commercial quality drones also improve the ability to create 3D models especially for medium and large bridges. Images that are captured with a commercial UAS are higher quality and allow for either a rapid collection of data or a significantly better deliverable.

While individual images of bridge components are a traditional and important aspect for bridge inspections, the ability to create 3D models of bridges allow for improved deliverables. Bridge inspectors can better document bridge conditions and clearly communicate inspection results to bridge owners with 3D models. Reality modeling software allows for still images and video to be processed and analyzed, regardless of the UAS platform used to collect data in the field. Additional new technologies including automatic ground control targets and QR Codes were explored and implemented in field data acquisition for this project. In addition to reality modeling software, this project also explored the use of software for automatic crack detection which is a promising technology that can improve the ability to both identify and quantify defects. These improvements in reality modeling software continue, making it more accessible and feasible on a wider range of bridge inspections.

The following is a summary of the technologies utilized during Phase IV of this study to provide an outlook of how UAS technology is quickly progressing with improved benefits and the removal of limitations.   The technologies discussed include both new and established UAS platforms, equipment, and software.

2.1 COLLISION TOLERANT AND OBSTACLE AVOIDANCE UAS

As part of the Phase II study, it was identified that there are many areas within bridge inspection that are prohibitive for imaging using a larger mapping UAS. Additionally, these are often the same areas that are very difficult, or even impossible, for inspectors to gain visual or tactile access due to environmental hazards and entry restrictions. The concept of a collision-tolerant UAS was explored as part of the Phase II study. The concept of obstacle avoidance was explored as part of the Phase IV study. Other options were considered to access these hard to reach areas with a smaller micro-UAS, larger propeller shrouds, or additional acoustic anti-impact sensors. Some benefits and limitations of both UAS platforms utilized in this phase are listed in the following.

2.1.1 Flyability Elios

MnDOT purchased an Elios in 2018 for use in confined space and close-quarters bridge inspection. At the time of purchase, the collision-tolerant was the most cost-effective option. Some of the benefits and limitations of the Elios are listed below.

Recognized benefits of an inspection specific collision-tolerant UAS are the following:

- Risk of damage is very low.
- Ability to navigate areas of a bridge that are difficult to access.
- Ability to roll: The protective frame can serve as a rolling device to better control the UAS, save battery life, and maintain a fixed distance from the face of an object. It was ideal for inspecting wide flange beams and concrete deck soffits by rolling the UAS along the top side of the bottom flanges.

Figure 2-1 Elios Rolling Along an Abutment Bearing Seat.

- Set-Up: Due to the simplicity of the equipment and interactive flight type, set up and site assessment are quick processes (typically 5 minutes).
- Lighting: The UAS is equipped with on-board lighting which is required due to fluctuating light/dark environments and proximity to elements.
- Safety for the inspector can be greatly improved by eliminating the need for confined space entries, risks associated with access equipment, and working from heights.
- Safety for the traveling public can be improved by eliminated traffic control and lane closures.

Recognized limitations of an inspection specific collision-tolerant UAS:

- Short battery life: The added weight of the protective frame and equipment reduces the allowable battery size, and thus reduces the battery life. A single battery operating under proper piloting conditions and operation yielded an average of 10 minutes of flight time, which limits its range and coverage. Swapping batteries is a quick process which mitigates this limitation.
- Video Interference: The protective frame is outside the video payload, meaning the frame will always be in the video partially obstructing the view.
- Air Flow and Debris: While operating in confined areas or near object surfaces, the UAS can create air flow eddies which affect the UAS flight. In addition, operating in close proximities to surfaces kicks up dirt and debris which can damage the propellers and interfere with video quality.
- The approximate cost of the Elios 2 drone is $35,000 USD.

Since Phase II of this study, Flyability has released a second generation of the Elios, the Elios 2. It was not implemented in the field for this study, but many of the new features on the Elios 2 address some of the disadvantages and have new benefits for bridge inspection. Benefits of the Elios 2 include:

- Fixed Frame: The protective frame has been fixed and an opening has been implemented near the camera to create an unobstructed view for the 4K and Thermal cameras. This makes creating 3D models from the UAS possible.

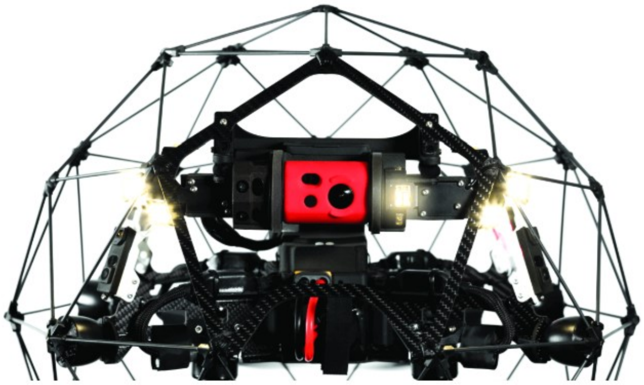


Figure 2-2 Elios 2 Protective Frame with Unobstructed View

- Dust Proof Lighting: The Elios 2 contains a 10,000 lumen lighting package that is offset from the camera to help eliminate overexposing images with close proximity to dust and debris.

Figure 2-3 Elios 2 Dust Proof Lighting Comparison

- GPS-Free Stability and Obstacle Avoidance: Using cameras and on-board sensors, the Elios 2 creates a virtual bubble around itself to stabilize and avoid contacting surfaces. This also allows a distance lock feature for easier navigation and viewing.

2.1.2 Skydio 2

The Skydio 2 is manufactured by Skydio as displayed in the image below is the second UAS platform made produced by Skydio. The Skydio 2 was initially marketed to adventure enthusiasts for cinematic use but has also been developed with inspection specific enterprise features includes the ability to use obstacle avoidance with a shorter 1 foot range. The environment in which this UAS was created require autonomous flight through dense wooded areas and AI (Artificial Intelligence) capable of real-time navigation around obstacles. To accomplish this, the Skydio has a state-of-the-art obstacle avoidance and object sensing technology. Skydio produces and develops UAS in the United States.

Figure 2-4 Skydio 2

The Skydio's autonomy system and navigation camera system consist of a high-speed video processor and an on-board camera payload which create a real-time point cloud of the world around it. The onboard processor can create over 1 million points per second at a rate of 500 iterations per second. The camera payload for navigation consists of 6 cameras in a triangular configuration on the top and bottom. Each camera is a 4k Sony sensor with a super fisheye lens (200-degree field of view) creating a 360-degree coverage of the environment around the camera. The generation of a 3D real-time point cloud in conjunction with AI based autonomous flight makes the Skydio an ideal candidate for flying in close proximity to bridge members, confined space and through bridge trusses.

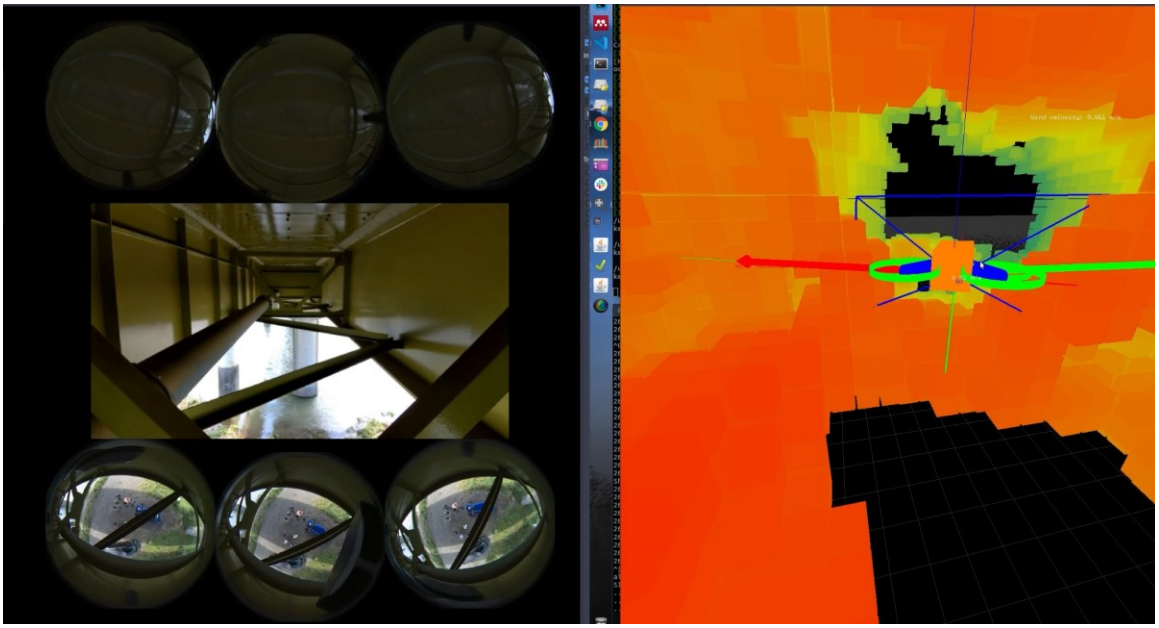


Figure 2-5 Skydio 2 Generated Point Cloud Environment Between Bridge Beams

Figure 2-6 Skydio 2 Flying in Tight Area Using Obstacle Avoidance

The onboard primary camera system consists of a Sony 12.3MP sensor capable of 12MP HDR still-photos or 4k HDR video. While this resolution of imagery is on the lower end of professional cameras, the ability to fly within inches of an object or surface makes the 12MP sensor more than adequate for bridge inspection. The following are some benefits and limitations of the Skydio 2 that have been recognized as a result of this study.

Recognized benefits of the Skydio 2:

- Approximate price tag of $2,500 USD (Jan. 2021) Which includes the hard case and additional batteries. Enterprise features cost and additional $1,500 per year.
- 3D point cloud-based obstacle avoidance
- Rigid frame construction provides for a more rugged and reliable platform
- 4k HDR video capabilities allows for ideal images in all lighting conditions
- GPS receiver for accurate position data, image tagging, and stabilization
- 23-minute battery life

Recognized limitations of the Skydio 2:

- Low resolution primary camera makes the UAS less than ideal for large area mapping or bridge modeling.
- Six navigation cameras on top and bottom with hemispherical lenses are exposed and has the potential to get scratched if not properly stored or cared for.

- No onboard lighting for internal confined space inspection
- Any moisture collection on the navigation cameras will prohibit flight

The results of exploring the use of collision-tolerant and obstacle avoidance UASs in bridge inspection were overwhelmingly positive. The relative ease of use and minimal set up make the collision-tolerant and obstacle avoidance UASs a great addition to an inspector's toolbox. With a price tag of approximately $2,500 USD (Jan. 2021), the Skydio 2 provides many of the benefits of the Elios at a lower cost. The Skydio 2 is certainly a tool for inspectors, which will help image previously difficult to reach or inaccessible bridge components. A video detailing the implementation of the Skydio 2 Drone for Bridge Inspections can be found here:

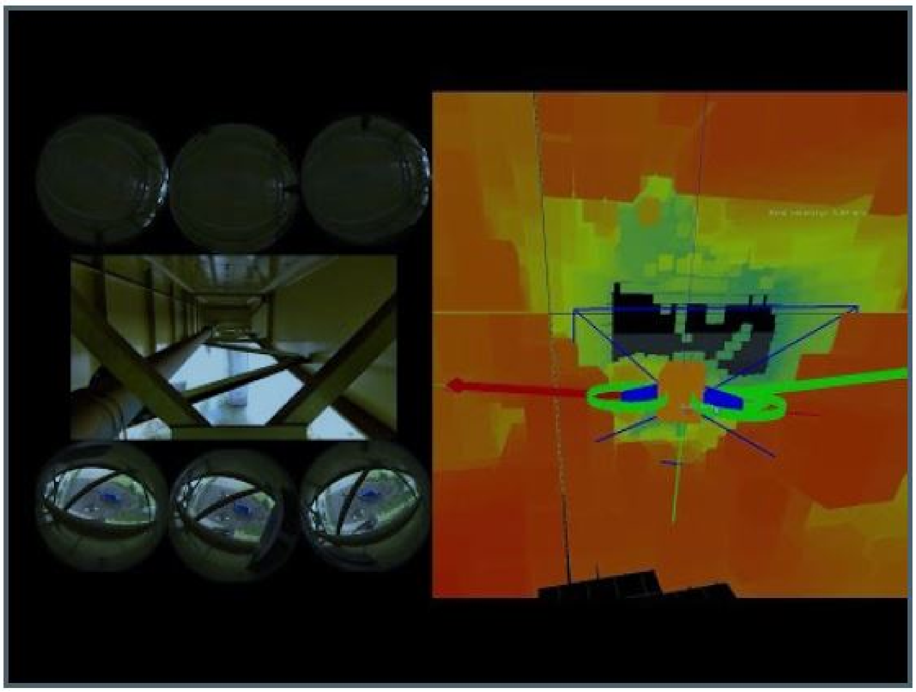


Figure 2-7 Skydio Bridge Inspection Video

2.2 CONSUMER GRADE UAS

Consumer-grade UAS platforms are beneficial due to their ease of use and general wide availability. Many consumer-grade UAS platforms can be purchased at retail stores or online at retail sites such as Amazon. Additionally, consumer-grade UASs are typically small, light, and easily transportable. They typically have a price tag around $1,000 USD. These attributes make consumer-grade UAS platforms ideal for routine inspection practices and modeling of bridges 150 feet long or less. For this study we used the Parrot Anafi, but many other similar drones exist with similar features such as the DJI Mavic.

2.2.1 Parrot Anafi

The Anafi UAS platform is manufactured by Parrot. Parrot is the parent company of SenseFly who created the Albris and Ebee. Due to the successes of the Albris, Parrot built in many of the essential inspection specific features into the Anafi. One major feature is the ability for the gimbal to pan 180 degrees vertically up or down. The Anafi has a primary camera capable of 21MP wide field, HDR still images, or 4k HDR video. The Anafi also features a 2.8x optical zoom for lossless (non-digital) image magnification and an ISO range of 100 to 3200 for excellent performance in low-light conditions. A thermal version of the Anafi is also on the market which contains an onboard FLIR Lepton 3.5 radiometric thermal camera.

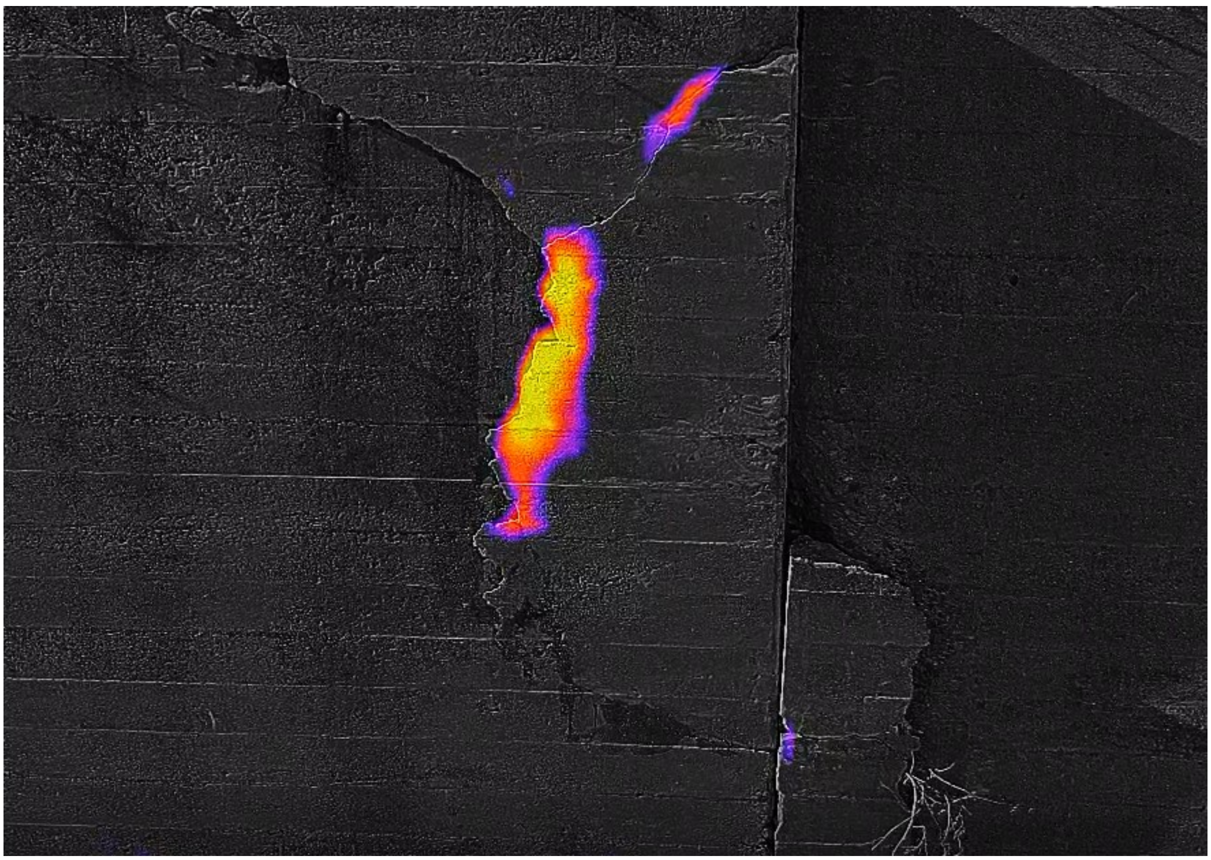


Figure 2-8 Image of Concrete Spall from the Anafi Thermal

The Parrot Anafi folds up into a roughly 10in x3 in x3in block which makes it very portable. It can be flown from either a controller using a tablet or phone as the screen or flown from a phone or tablet directly. Several phone apps such as Pix4DCapture and Drone Deploy provide excellent on-site mission planning for near commercial-grade quality of aerial mapping and 3D modeling. The Anafi is not manufactured in China which makes it a candidate for use with government sectors such as military or the Department of Defense.

Figure 2-9 Parrot Anafi

The Anafi has onboard acoustic sensors, a GPS receiver, and a propriety digital stabilization technology which all aid in flight stabilization. The UAS is programmed with return to home features and geofence options to provide a safe and reliable working environment. The UAS has a battery loaded weight of 13.6oz and can withstand sustained winds of up to 31mph. These features make the Anafi a safe UAS option and low risk in comparison to other standard methods of bridge inspection. The following are some benefits and limitations of the Anafi that have been recognized as a result of this study:

Recognized benefits of the Anafi:

- 21MP HDR still camera ideal for terrain mapping and modeling
- Small carry size makes easy to deploy in the field
- Easy to set up and to fly
- Lightweight and poses no greater risk to public than a medium size bird
- Low cost compared to commercial UAS platforms
- Small profile provides limited distraction to surrounding public
- Camera gimbal capable of looking vertically up or down

Recognized limitations of the Anafi:

- Limited mission planning software
- Limited use in high wind or moist conditions
- No on-board obstacle avoidance
- Folding frame not as durable as a fixed frame
- Lack of reliability
- Lack of customer support

2.3 COMMERCIAL GRADE UAS

Commercial UAS platforms typically vary from consumer UAS platforms by price and quality of product. The two commercial UASs discussed below are the Intel Falcon 8+ and the Sensefly Albris. They both carry a price tag into the 10's of thousands (Feb 2020) and boast high resolution camera payloads with extensive mission planning software. These commercial UAS platforms carry all the benefits of the consumer grade UASs with added safety, reliable mission planning, and execution features. It was realized during Phase IV that environmental factors such as locations (urban vs. rural), distance of flight, and size of bridge govern what UAS platform is best selected. The largest differentiator with commercial UAS is image quality. Commercial UAS typically have image sensors with at least double the resolution of consumer grade drones. Also important is the reliability of commercial UAS and the flight planning software that typically is far more sophisticated than consumer UAS.

2.3.1 Intel Falcon 8+

The Intel Falcon 8+ UAS is a commercial platform featuring best-in-class redundant hardware, GPS, and sensor package with a high-end image payload. The Intel UAS consists of a rigid frame with 8 rotors, cockpit controller, interchangeable imaging payload mounted on a front center gimbal, and uses propriety Intel software for mission planning and post processing. This model can fly under bridge decks, and the camera can look straight up. The battery last for 15 minutes for a typical mission but with the high-resolution sensor this drone can collect a large amount of data per flight. A typical inspection mission can collect 375 42MP images in one flight. This UAS was used extensively throughout Phase IV. Overall, the experience and deliverable created using the Intel Falcon 8+ was the highest quality that has been achieved throughout all four phases of this research project.

The Intel Falcon 8+ features carbon fiber frame construction consisting of 2 rail bars in a V-shape. Each rail houses 4 rotors. At the center of the V is the payload and processing housing. The configuration of rotors allows for flight in wind speeds in excess of 30 mph. Furthermore, the lightweight construction provides best in class weight to payload ratio for excellent flight time. The V-shape provides for an unobstructed field of view from vertical down, 180 degrees to vertical up. The onboard electronic and hardware system features triple redundant flight control with three redundant Internal Measurement Units for quick and reliable data processing of position, altitude and orientation for excellent responsiveness and stability. The 8 rotors, dual batteries, and multiple communication links also offer built-in redundancy for optimal safe operation.

Figure 2-10 Intel Falcon 8+ Platform

The cockpit controller is the main control interface with the Falcon 8+ platform. The controller features a built in 8-inch touch screen display for imaging and flight planning and a designated 2-inch system information display for system vitals. The controller has two main joysticks similar to traditional UAS platform controls. However, the right joystick has an additional rotational sensor which makes single hand flight control possible at a set altitude. Toggle switches built into the sides of the controller allow for image payload operation with a single hand. With the innovations of this controller, it is possible for a single pilot to flawlessly fly a manual mission at a given altitude while simultaneously operating and manipulating the imaging payload.

Figure 2-11 Intel Falcon 8+ Cockpit Controller

The interchangeable imaging payload of the Falcon 8+ is what sets this UAS apart from other Commercial UAS platforms on the market. Several payloads exist for this platform. Two that stand out specifically are the survey package consisting of a Sony Alpha 7R full frame DSLR camera and the inspection package consisting of a near-infrared and full frame DSLR camera. The Sony Alpha 7R camera contains a full frame 36MP sensor with photography industry leading processing for excellent imaging in all lighting conditions and optimal image color and sharpness characteristics. The inspection package integrates infrared with full frame photography or high-definition video for real time image overlays and the ability to accurately locate and stamp defects in the field.

Intel Mission Control is a proprietary software suite created by Intel for mission planning for the Falcon 8+. The software features several mission types which can each be flown in series and edited to suit any flight condition. The software also allows for importing digital surface models created from higher altitude initial site flights. This provides a detailed background 3D image to plan flight missions.

Figure 2-12 Intel Mission Control Flight Plan

The realized benefits of the Intel Falcon 8+ UAS is the high quality, high precision images that allows for optimal inspection through post processing and a platform that is highly redundant, safe, and resilient to wind, electromagnetic, or various other external influences. Some of the realized limitations of the UAS is the high cost and lack of obstacle avoidance. The overall experience with the Intel Falcon 8+ was very positive, and it proved to be a reliable and durable platform for a best-in-class imaging payload.

Recognized benefits of using the Intel Falcon 8+ UAS:

- Ability to view vertically up and down
- Option of pre-programmed flight or interactive flight (manual flight controls)
- Most advanced flight planning software on the market for complex 3D flights
- High-Resolution high quality images
- Ability to fly without GPS signal
- Up to 15 minutes of usable flight time

- Ability to collect a large amount of data in a short amount of time
- Hardware and software are both resilient and reliable

Recognized limitations of the Falcon 8+ drone:

- Not suited for flight within confined space
- Size of drone and controller makes it difficult to transport easily in the case

2.3.2 Sensefly Albris

This UAS was used in Phase II and III, and then was partially replaced by the use of the Intel Falcon 8+ in Phase IV. Given the overwhelming positive results from Phases II and III, this UAS is still a very suitable and useful tool in inspection. The manufacturer, Sensefly has discontinued the production of the Albris and has halted the progression of their quadcopter development program. Sensefly's parent company, Parrot, has produced the Anafi which implements some of the advantages of the Albris at a much lower cost.

The SenseFly Albris UAS platform was designed for commercial inspection and mapping purposes. This model can fly under bridge decks, and the camera can view straight up. The Albris UAS can be controlled interactively with a controller or autonomously with a pre-programmed flight. Both flight modes utilize a laptop computer to control the UAS. The flight control software contains the UASs settings, which include a real-time map that displays the UAS's location, live image views, and flight data. The software can also be used to plan and monitor autonomous flights. The UAS is approximately 22 inches by 32 inches by 7 inches and weighs 3.96lbs, allowing for easy handling and transportation. The batteries typically provide up to 215 minutes of flight time when operating under safe manufacturer guidelines. Flight hardware restrictions include wind speeds greater than 22 mph, a range that is over 2.8 miles away, or speeds in excess of 26 mph.

Many of the positive physical specifications and limitations of the Albris have been either duplicated or enhanced in the Parrot Anafi. However, the Albris retains its position in the commercial UAS due to the imaging payload which consists of a TripleView head containing a high-definition video camera, a 38 Mega-Pixel (MP) still camera, and an infrared camera. The 38MP camera is the primary data acquisition tool. The absolute horizontal/vertical accuracy of the UAS is reported at 3ft to 16ft without using ground control points and down to 0.04 in when using ground control points.

Figure 2-13 Sensefly Albris TripleView Payload

Recognized benefits of using the Albris UAS:

- Ability to view vertically up and down
- Option of pre-programmed flight or interactive flight (manual flight controls)
- High-Resolution Photogrammetry
- Ability to fly without GPS signal
- Up to 20 minutes of usable flight time
- Distance Lock and Cruise Control
- Onboard LED lighting and camera flash

Recognized limitations of using an inspection-specific mapping and photogrammetry UAS:

- Not suited for flight within confined space
- Set-up is time consuming and requires a laptop, stand, antenna, tripod, and a continuous power source for the laptop.

2.4 TERRESTERIAL IMAGING PLATFORMS

This study focused primarily on the implementation of UAS in bridge inspection, but it was quickly realized that the post processing technology could be an asset to inspectors using traditional terrestrial photography. Terrestrial photography refers to the use of an imaging platform which is held or mounted to something founded on the ground. In certain environmental conditions or regulatory situations, UASs cannot be safely flown but, the ability to develop a model or 3D photo log still exists with the use of post processing software.

2.4.1 Point and Shoot Cameras

Traditionally, inspectors' toolboxes contain a point and shoot digital camera for capturing defect photos. Using traditional cameras is natural to inspectors and thus, can be implemented with a relatively low additional cost for equipment. Photos taken using any modern digital camera can be an input for post processing software, however the deliverables greatly improved if the camera has the following features:

Figure 2-14 Point and Shoot Digital Camera for Photogrammetry

- GPS Location Enabled: Creates a geo-located image to assist post processing software to order and match images for a model or map.
- High resolution sensor: A camera having a 12MP or greater will allow for a model to be generated and can greatly enhance. In most cases the better resolution, the better the model.
- HDR (High Dynamic Range) Still Imagery: HDR provides excellent photography in all lighting conditions. Often with terrestrial imagery, sky, sun or bridge backgrounds are captured while obscuring the focus on dark elements such as bearing or bridge soffits. HDR imagery assists in consistent image lighting, reducing instances of over or under exposure and saturation.
- Water / Dust / Impact Resistant: Inspection conditions are often in wet, dirty, and tough environments. Waterproof, shockproof, and dustproof camera features provide inspectors a durable and reliable platform with the potential use of underwater imagery for submerged element modeling.

2.4.2 Commercial DSLR Cameras

Figure 2-15 DSLR Digital Camera for Photogrammetry

Less traditional to inspectors is DSLR (digital single-lens reflex) cameras. DSLR cameras are commercial grade, high resolution digital cameras. The benefits of these platforms are very high-resolution sensors, typically 36MP or more, which yields images that can display small defects from relatively far distances. The user input settings create better quality images in low light conditions or high-speed photography but requires the user to have a significant understanding of photography. GPS enabled feature are not as common in DSLR cameras and they are much less durable in wet or rough environments, which limits their use in inspections. A variety of aftermarket lenses such as wide angle or optical zoom options are available for these cameras, but not all are recognized by the post processing software. The use and type of a DSLR camera and lenses should be determined and vetted through post processing software prior to implementing in the field.

2.4.3 Smart Phone Cameras

The largest change and increasing potential in photography platforms is smart phones or tablets. Many phone/tablet producers are making their cameras and image processing focal points in their list of features. The significant ease of use, requiring very little knowledge of traditional photography, makes smart phone or tablet imaging a very reliable deliverable. Additionally, smart phones and tablets continue to have increased resolution sensors which compete with or exceed the ability of point and shoot cameras. Most modern smart phones and tablets have excellent GPS signal and are durable and resilient to wet or tough conditions. Most inspectors carry some version of a smart phone and, in lieu of other technologies, can use these for quick on-site imaging. Some smart phones and tablets are introducing (Feb 2020) LiDAR and other imaging payloads as a supplement to their on-board imaging payload which will further set these data acquisition tools apart from traditional point and shoot cameras.

2.5 PROCESSING TECHNOLOGIES

After data is collected in the field in the form of images, GPS tags, ground control and manual tie points the next step is to process that data into deliverables. These deliverables can be in many formats including 3D reality models, 2D orthomosaics and 2D orthoplanes all of which can be geometrically and geospatially correct on the order of sub-centimeter accuracy. These outputs can be used locally or shared with others via cloud platforms. Many software platforms exist to create deliverables and our study is not intended to give recommendations on specific software but, to discuss and compare in general terms the features that are beneficial to bridge engineers. Bridges can be challenging to successfully process because the geometry is complex and mapping the underside of the deck along with the entire bridge takes careful planning and execution in the field. Post processing software is as important as the drone hardware and often gets overlooked in the process. Our team used Pix4D and ContextCapture to process reality models and used Fuji Film Infrastructure Photo Analysis and ContextCapture Insights for artificial intelligence applications.

2.5.1 Post Processing Technologies

2.5.1.1 Computer Configurations

Throughout Phases II, III and again, in Phase IV, computing power was foreseen as an issue in processing 3D models efficiently while still delivering a quality product. In several cases where large bridges were imaged using a full frame DSLR camera using preplanned mission software, the raw data files were exceeding 100GB of imagery. On smaller bridges using manual photography and medium resolution cameras, data collected was still typically exceeding several gigabytes. It was quickly realized that to roll out a deliverable in an efficient timeframe, custom built computers would be required to process all the data. In addition to the computer processing being an issue, transfer of files over the internet or FTP sites became very tedious due to size of files and folder. Cloud-based technology and processing was implemented in Phases II through IV and is still a very efficient method of processing; however, from a security, ownership, and user input standpoint, it is still not capable of handling all jobs.

Figure 2-16 Custom Built Post Processing

2.5.1.2 Pix4D Software

Our team used Pix4D for many of our bridge inspections and there are many benefits to this software. It is relatively easy to learn and use. The cloud sharing platform is very good and provides many tools useful for bridge inspectors. Pix4D stores and displays all original high-resolution images and ties them to each pixel created as a result of that image. This can be thought of as a 3D photo log where a user can view an entire bridge model and select in space where they would like a close-up photo view of. There is also a virtual inspection tool on the cloud platform which allows a user to click on the model and view images of the area they clicked. This feature is very useful to a bridge inspector to be able to find and compare deficiencies over time.

Pix4D software processes the images taken in the field from a handheld camera or UAS in a .jpg or .tif file format and triangulates the photos to form a 3D interactive model. The model can be used to accurately measure distances, areas, and volumes with GPS located images or GCPs. When completed the model can then be uploaded to the cloud, annotated, and sent as a deliverable. The deliverable can be in either 2D or 3D. Pix4D can produce Orthomosaics from a user-defined orthoplane and index maps (Thermal, etc.) in 2D. For 3D output results, it produces 3D PDF, 3D texture mesh, point cloud, and contour lines. Pix4D can struggle with complex 3D models and can create noise in the models especially at bridge railings. This noise can be removed but this is a manual process which add time to the workflow.

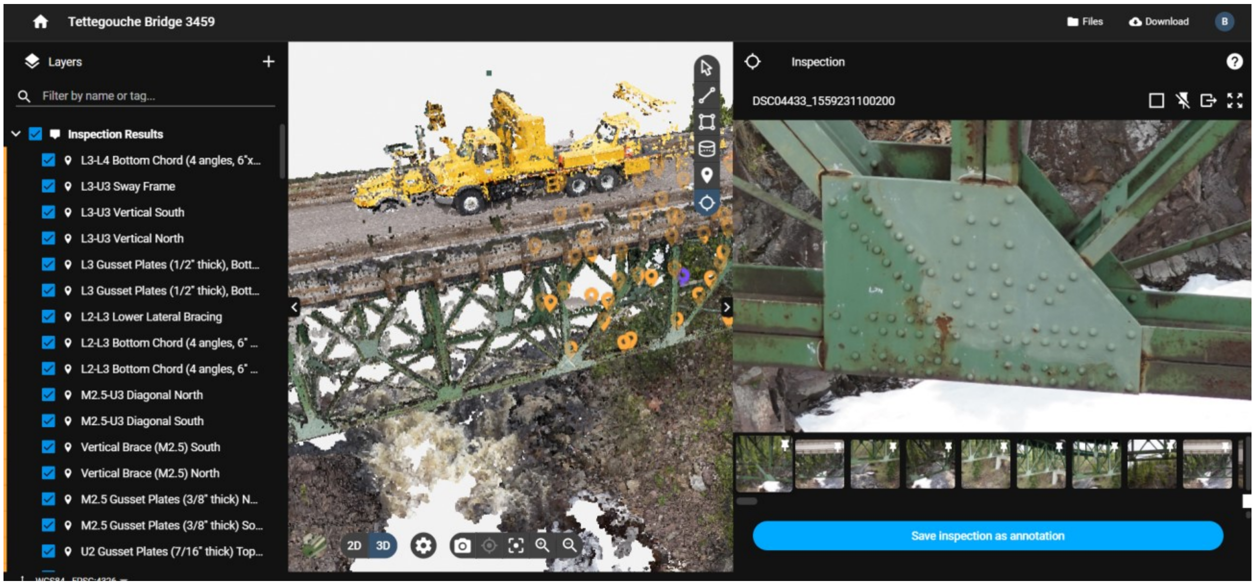


Figure 2-17 Pix4D Cloud Virtual Inspection Tool

2.5.1.3 ContextCapture

ContextCapture from Bentley was the other software package we used in our study. ContextCapture can create many deliverables similar to Pix4D and has similar tools. ContextCapture has a slightly longer learning curve but excels at creating very clean reality models of complex structures. Another advantage is that multiple computers can be used to process one project which can speed up the processing significantly. ContextCapture also seamlessly integrates with Microstation CAD software which many DOT's use as their preferred CAD platform. Models can also be shared via the Projectwise software but requires uses to register with Bentley to view the models.

Collins Engineers and MnDOT have been working with Bentley to use the ContextCapture models in the Microsoft Hololens 2 which is a significant leap forward and presents a unique and effective way to perform virtual inspections. More information can be found in section 2.5.2.1.

2.5.1.4 FujiFilm Infrastructure Photo Analysis

Collins Engineers and MnDOT have been working with FujiFilm Japan on their upcoming Infrastructure Analysis Software. This artificial intelligence software tool automatically detects and classifies cracks on concrete structures. While the tool can find cracks on any concrete bridge element, it is especially effective and useful for mapping deck cracks as the process has been particularly difficult to do in the field because it is time consuming, inaccurate and has safety concerns since lane closures are often necessary. The software classifies cracks by width and the data can be downloaded in a spreadsheet to extract quantities for the bridge inspection database.

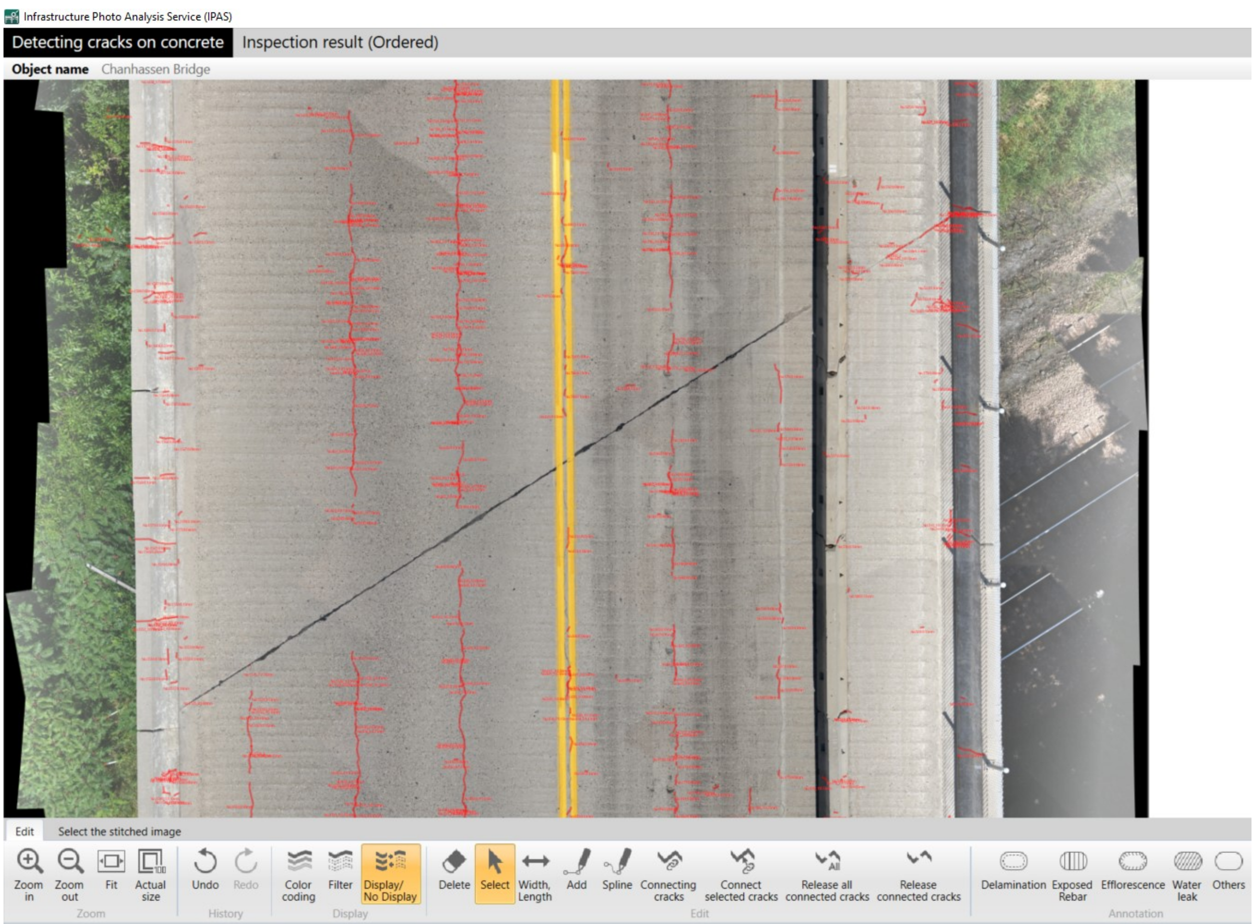


Figure 2-18 Fuji Film AI Crack Detection on Bridge

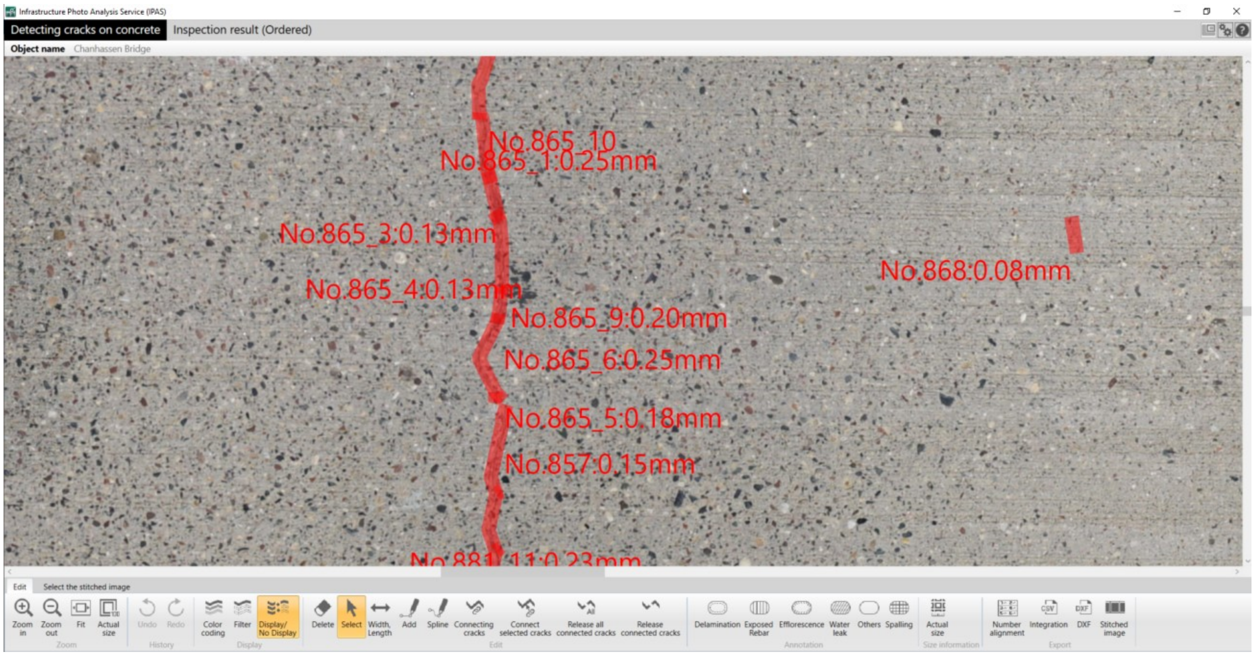


Figure 2-19 Fuji Film AI Crack Detection on Bridge Deck Close Up

2.5.2 Processing and Modeling Accessory Hardware

These types of aids consist of products, targets, or other visual aids that are placed in the field prior to UAS flights and are captured in the images to aid in processing. They can be as simple as paint or chalk markings or unique stickers placed on critical faces. These are easy to apply in the field, but require an understanding of the post processing technology to find the best place to create or install marks. Smart technologies such as survey-grade GPS targets or QR codes can be used by inspectors to achieve higher quality results with less user input in post processing. These smart technologies also must be implemented with an understanding of the post processing software to insure they are compatible and efficient.

2.5.2.1 Propeller AeroPoints

AeroPoints are drone specific aerial targets that record their own position using GPS, which is processed and corrected to ensure survey grade accuracy. Benefits of this technology is that inspectors do not need traditional base and rover surveyors to mark benchmarks prior to flying and these serve as both the GPS collector and the image target in one package. In Phase IV, our team used the Propeller AeroPoints with great success and reliability on inspections as large as 9-mile-long corridor surveys to one-mile long bridge inspection models. The use of these smart targets greatly increases the accuracy of your survey or model from +\- 3-foot accuracy to sub-inch accuracy.

Figure 2-20 Propeller AeroPoint UAS Survey Target

2.5.2.2 QR Codes

QR Codes (Quick Response Codes) is an adaptation of traditional 1-dimensional bar codes. QR codes contain a 2D matrix of pixels which are unique and can contain location or identification information. Placing QR codes on targets in various places during a bridge inspection site prior to imaging can greatly increase the efficiency of processing and quality of the final product. QR code images are publicly available and were implemented during Phase IV. The size of the QR code was examined to determine the optimum target for a camera resolution at a given distance. Application of QR codes to different mediums were explored to test the durability, reflectivity, ease of application, and longevity of each installation. The type of target and method of adherence was proven to be independent of the specific bridge material and environment; however, the application of QR codes was proven to work in nearly any bridge location or condition.

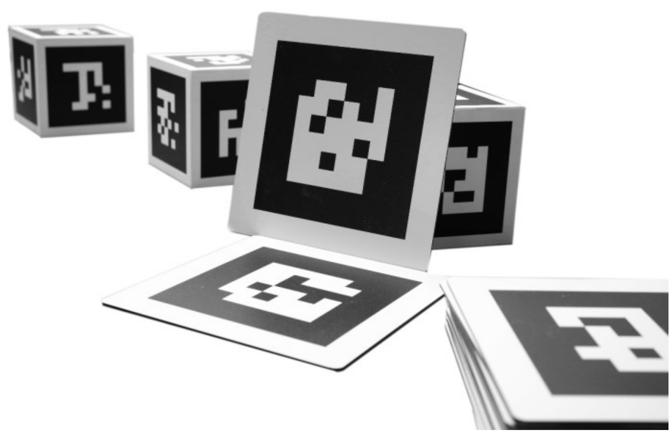


Figure 2-21 QR Code Targets Created and Used in Phase IV

A bridge design maximizes redundancy not only with loads, they also have repetitive components, geometry, and designs. These repetitive structures bring challenges in post-processing software and often requires a lot of manual input by creating manual tie points in the 3D models. This difficulty only increases with more complex structures like trusses.

Pix4D software, which was the primary post processing software used in Phase IV, stiches images together by producing a point cloud through computer generated key points called Automatic Tie Points (ATPs). This action is done through Pix4d's initial processing step and any intermediate steps of reoptimizing or rematching run by the software.

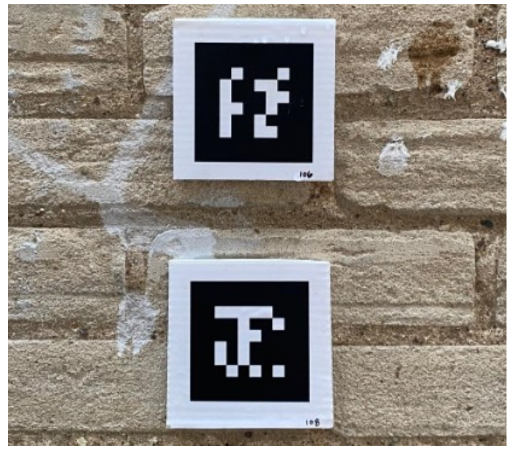


Figure 2-22 QR Code Targets Adhered to a Stone Face

If the software is uncertain about surfaces or areas, it may produce a model that is incorrect and requires an engineer to enter Manual Tie Points (MTPs) in the model to improve model accuracy and clarity. This method is generally used after the first step is processed where the user can focus on areas of concern. Once an area is identified to improve, the user cycles through the images calibrated within the chosen area to manually mark or adjust key points. This process can be very tedious and time consuming on large structures.

To alleviate some of this engineer manual processing, Pix4D developed a system called Pix4D Tagger, a tool to implement during the acquisition of the data. This is done by placing custom QR codes recognized by the software, scattered around the subject to be imaged for a 3D model. This frontend step generates artificial points to run in the modeling process as MTPs. These points imported into Pix4D provide extra data for the computer to process allowing more accurate initial model and decreasing manual input required to increase accuracy of a model.

Pix4D Tagger utilizes custom QR codes, each with a unique ID from one another. Each tag creates four individual key points on the corners of the square code identified by the software. These tags can be oriented in anyway throughout the area being imaged as the software can identify the unique code and compute the numbering convention. The image shows an example of a Pix4D QR code and its numbering convention of the artificial key points.

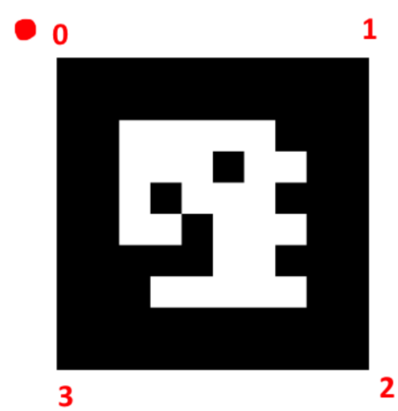


Figure 2-23 Pix4D Tagger QR Code Example with Numbering Convention of the Key Points

After placing the QR codes throughout the area to be imaged in conspicuous locations, the user can proceed as normal with acquiring UAS or Terrestrial Imagery for a model. The user will then import information from these QR codes into Pix4D as MTPs to aid in processing.

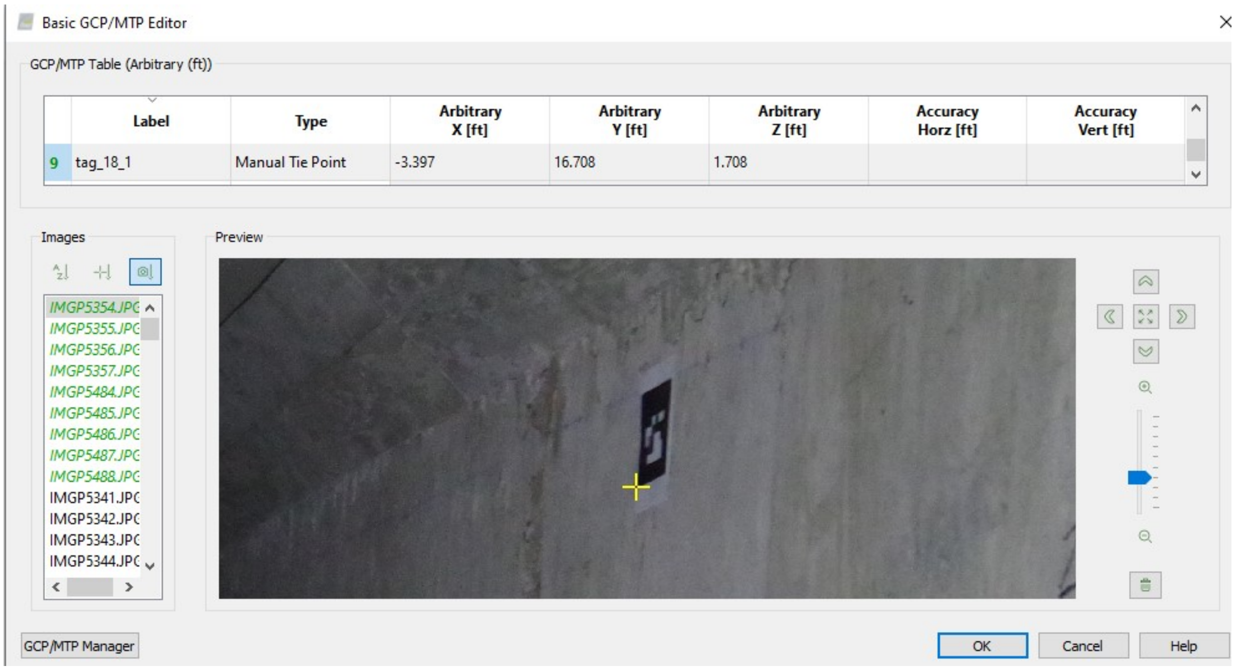


Figure 2-24 Pix4D GCP/MTP Editor Screenshot Showing Points Automatically Inserted on a QR Code.

Pix4D tagger is a huge benefit for projects which are complex requiring lots of manual input from the user. It provides extra data for the software to compute and ultimately increases its accuracy and decreases the amount of an engineer's time and effort.

2.5.2.1 Microsoft Hololens 2

Collins Engineers has been working with Bentley in developing software for the Microsoft HoloLens 2 to be able to perform virtual inspections using mixed reality. A 3D reality model can be loaded on a Hololens headset and the user can not only view the virtual bridge in a hologram but, can also make measurements, add notes, add and classify defects and denote elements. This data can then be integrated into the bridge inspection report database as condition codes and quantities. Utilizing mixed reality can allow users to populate or review inspection data from their office and allows for the sharing of bridge inspection data with experts in other locations.

Figure 2-25 Microsoft Hololens 2

Figure 2-26 Holographic Overall Bridge View from HoloLens 2

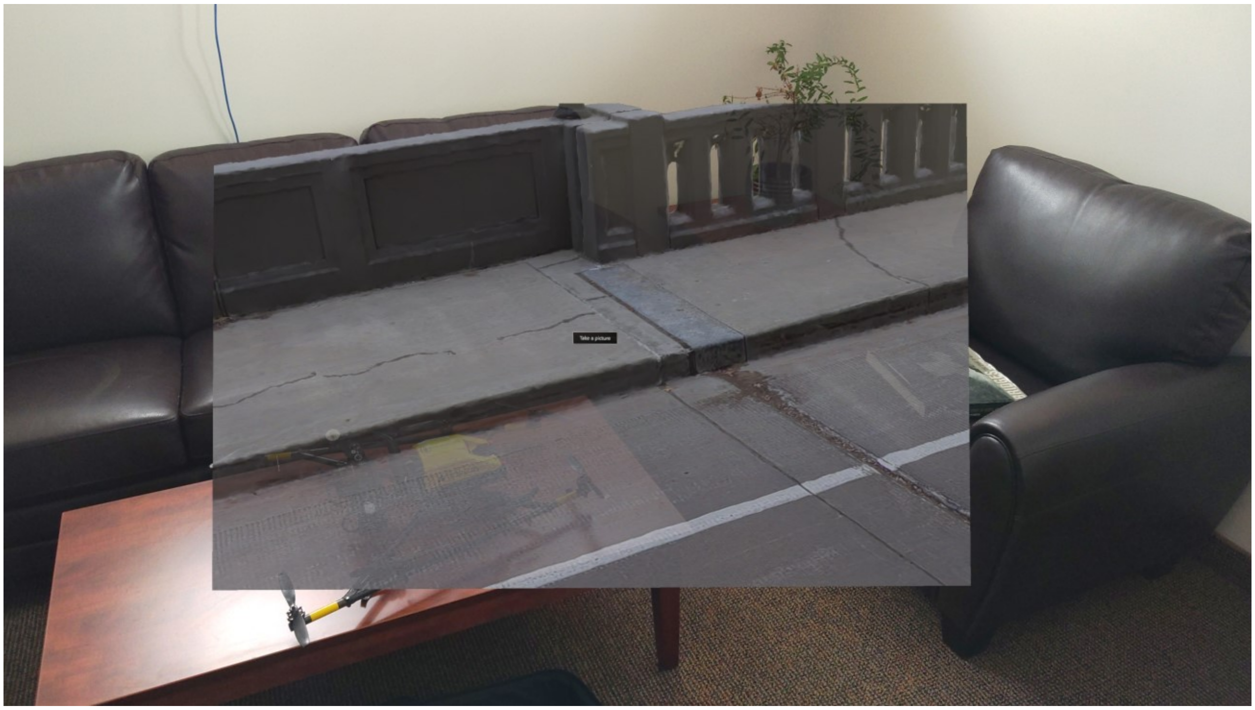


Figure 2-27 Holographic Close Up View of Bridge from HoloLens 2

2.6 FIELD TESTING AND CALIBRATION

2.6.1 Carver County Survey and AeroPoint Accuracy Report

The use of AeroPoints, in conjunction with the Intel Falcon8+ UAS platform, was implemented as part of a 9-mile corridor survey for Carver County in Minnesota to obtain a terrain model. This survey technique proved to have many benefits. It provided additional data than a traditional 'base and rover' type survey and was much more efficient and economic than an LiDAR survey. To ensure accuracy and to prove proper calibration of the UAS system using AeroPoints, Carver County surveyors set out 21 Check Points surveyed with traditional base and rover methods. These points were then compared to the final model which utilized 234 individually placed AeroPoints as Ground Control Points. A report was generated which compared the model points to the check point locations and calculated error. These results concluded that with the use of AeroPoints, a UAS survey using a commercial UAS platform can achieve sub-centimeter accuracy of an entire terrain area.

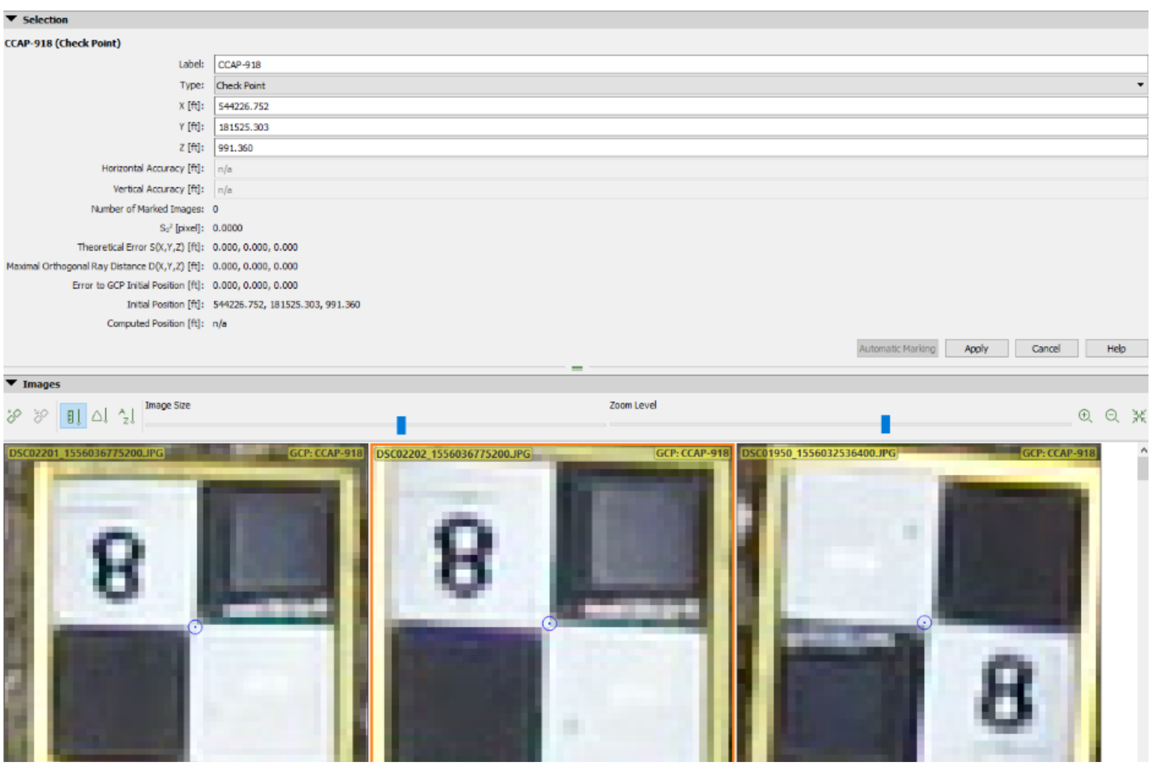


Figure 2-28 Pix4D Ground Control Point Editor Showing a Propeller AeroPoint

2.6.2 UAS Imaging Payload Test

UAS systems are the vehicle for data acquisition. For this research, the majority of data acquired was in the format of digital photographs. The quality of each camera payload and resulting photographs were studied as part of this phase and are summarized below. Some considerations include resolution, clarity, contrast, and exposure. Camera attributes were tested and compared on three UAS cameras that were part of the research project. UAS's were the Anafi Parrot, Intel Falcon 8+, and the Skydio 2.

Camera megapixels (MP) is a count of pixels, in millions, the camera can put into a square inch. The greater the data put into an image allows a digital zoom to be clearer and more defined. The importance of this attribute in UAS cameras for inspection directly affects several aspects for producing quality results including, but not limited to, the distance from the structure necessary to take photos, number of photos, and clarity and detection of defects. The three UAS platforms chosen all had different MP counts and sensor size:

- Skydio 2, 12 MP 1/2.3" CMOS
- Anafi Parrot, 21 MP 1/2.4" CMOS
- Intel Falcon 8+, 36 MP Full Frame (35mm) CMOS

2.6.2.1 Testing Procedure

Several tests were conducted in a field lighting environment. The tests included an optical test, pixel and resolution test with a field of view comparison. The tests were conducted by imaging the same location at predetermined intervals of 10 feet, 20 feet, 50 feet, 75 feet, and 100 feet. The location imaged included a calibrated visual aid situated 20 feet off the ground. Attached on the visual aid was an optical vision test, crack gauges, ruler tape, and resolution test targets.

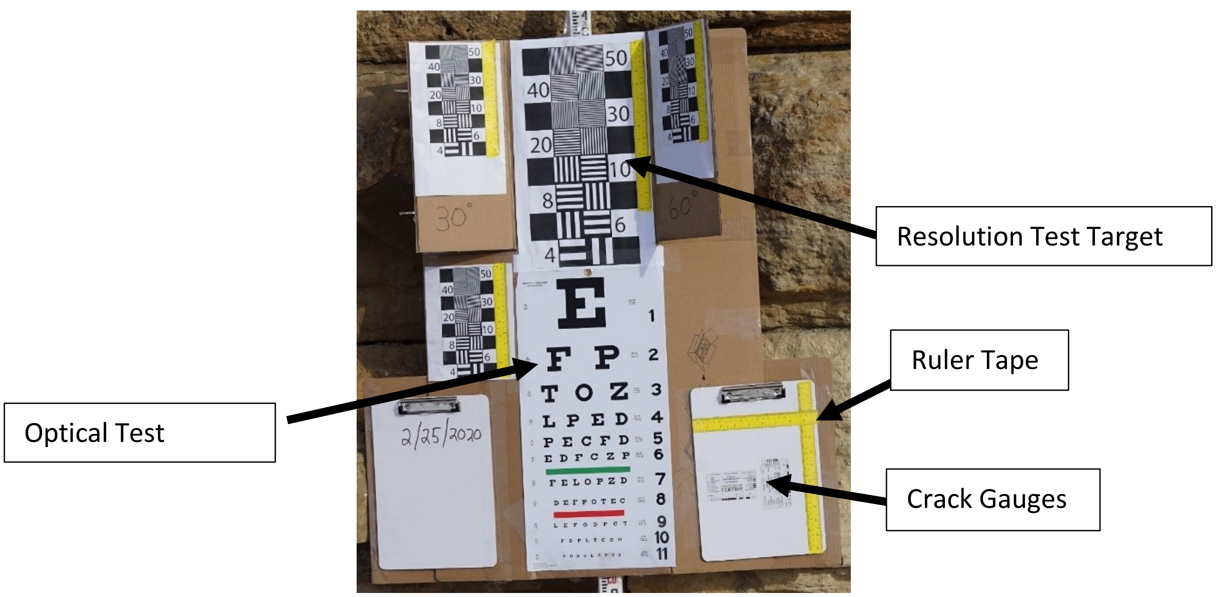


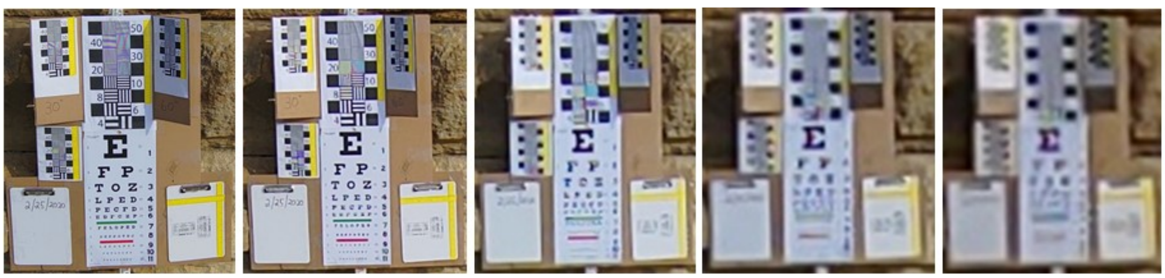
Figure 2-29 Layout of the Visual Aid Used for Testing.

Each UAS was manually flown on the same flight path to image the visual target at the determined distances. One picture was taken at each distance interval from each camera. Variables were limited as the visual aid included all material needed for the testing therefore, only one photo was needed per distance for each camera. Each photo was cropped and digitally zoomed in to the approximate same size for comparison and were reviewed under typical office settings.

2.6.2.2 Optical Test Results

The focus of this test was to evaluate the visual clarity between cameras at relative distances from an object. Each drone was flown individually and initially compared by itself at the different distances. The following information breaks down the results through visual interpretation of each camera at the different distances.

The Skydio, with a 12 MP 1/2.3" CMOS camera sensor, represented some visual issues after 20 feet when comparing the optical vision test. After 75 feet, line 2 on the optical vision test was difficult to differentiate 'F' and 'P'.



Skydio 10 FT | Skydio 20 FT | Skydio 50 FT | Skydio 75 FT | Skydio 100 FT

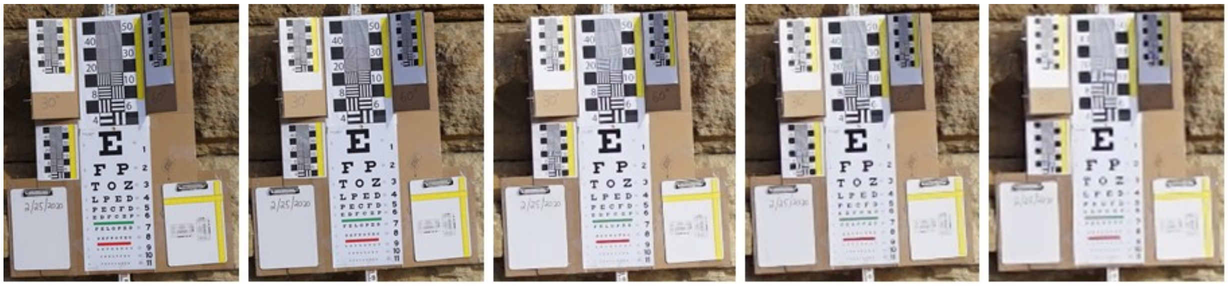
Figure 2-29 Skydio Image Comparisons at Determined Distances.

The Anafi equipped with a 21 MP 1/2.4" CMOS camera sensor performed better than the Skydio at 50 feet with more distinguished letters on the optical test up to line two at 50 feet. At the 75 feet distance and beyond, the Anafi became less clear although slightly better than the Skydio.

Anafi 10 FT | Anafi 20 FT | Anafi 50 FT | Anafi 75 FT | Anafi 100 FT

Figure 2-31 Anafi Parrot Image Comparisons at Determined Distances

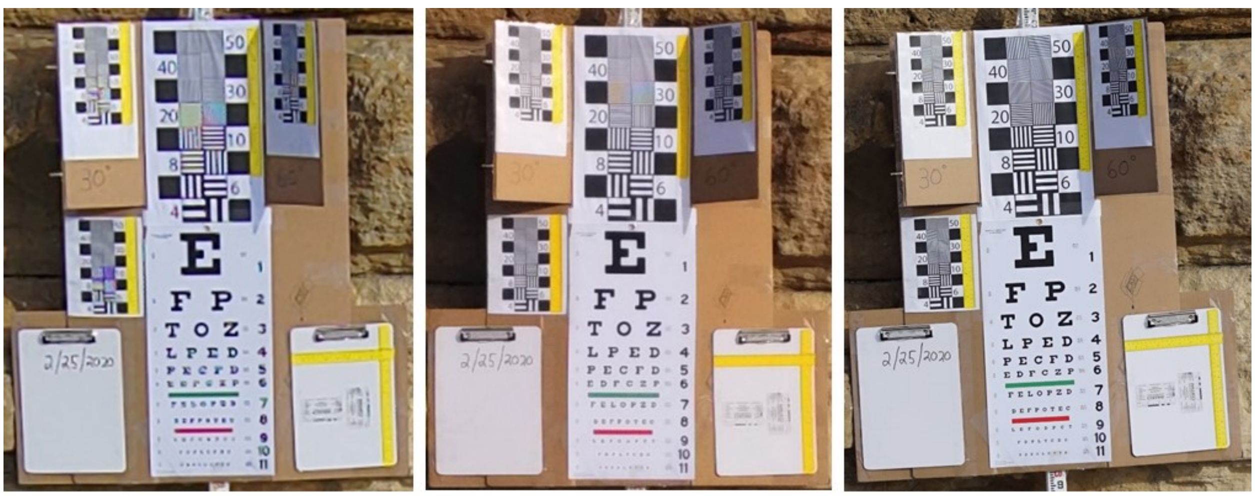
The Intel Falcon 8+ with the advantage of a 36 MP Full Frame (35mm) CMOS camera sensor produced a much clearer image up to 75 feet. The 100-foot distance was still comparable to the Anafi at 50 feet and the Skydio under 50 feet. This camera produced images that allowed zooming in digitally from a large distance away and maintained respectable clarity.



Intel Falcon 8+ 10 FT | Intel Falcon 8+ 20 FT | Intel Falcon 8+ 50 FT | Intel Falcon 8+ 75 FT | Intel Falcon 8+ 100 FT

Figure 2-32 Intel Falcon 8+ Image Comparisons at Determined Distances

The next comparison was between each drone using the parameters modeled after the visual acuity eye exams performed by optometrists. The test compares the actual subject's vision at 20 feet compared to the average human's normal vision. A direct comparison was conducted on the photos at the 20-foot distance, shown in the picture below.



Skydio 20 FT | Anafi 20 FT | Intel Falcon 8+ 20 FT

Figure 2-33 Comparison of the Three Cameras at 20 Feet Zoomed In

When the images were compared, there was a clarity difference in all the camera types. Each camera had a line where the legibility in the optical visual test was no longer clear. The list below summarized the last line that was clearly legible using digital zoom.

- Skydio, line 5 or an eyesight of 20/40
- Anafi, line 7 or an eyesight of 20/25
- Intel, line 9 or an eyesight of 20/18

The fraction designated above represents what the subject would see as legible at 20 feet compared to the standard eyesight. To put the UAS's imaging payload in perspective the standard human eyesight is

20/20, or the last legible line at 20 feet is line 8. The Intel Falcon 8+ had a relative sharper vision at twenty feet compared to the standard eyesight which would read line 9 at 18 feet.

Lastly, there was a distinct clarity difference related to the different camera payloads. The below image was a direct comparison of line 7 between all three drones highlighting the clarity differences.

Skydio 20 FT | **Anafi 20 FT** | **Intel Falcon 8+ 20 FT**

Figure 2-34 Comparison of the Three Cameras at 20 Feet for Line 7 of the Optical Vision Test

2.6.2.3 Resolution Test Results

The focus of the resolution test was to determine the limitations of each camera in visualizing cracks with several variables. The variables included the distance of the camera compared to the subject, the camera, and angle of subject relative to the imaging payload. This test used the same images captured during the visual test with a focus on the resolution test targets.

There were four resolution test targets on the visual aid with two different size targets. One size target was the larger boxes which corresponded with a two-inch square filled with several lines. The smaller boxes corresponded with a one-inch square filled with several lines. The number of lines in each standardized square was represented by the large typed number to the side. For example, the closeup below shows the number ’30’ with a smaller box measuring 1”x1”; meaning there were 30 lines in the 1”x1” square or each line being 1/30-inch wide.

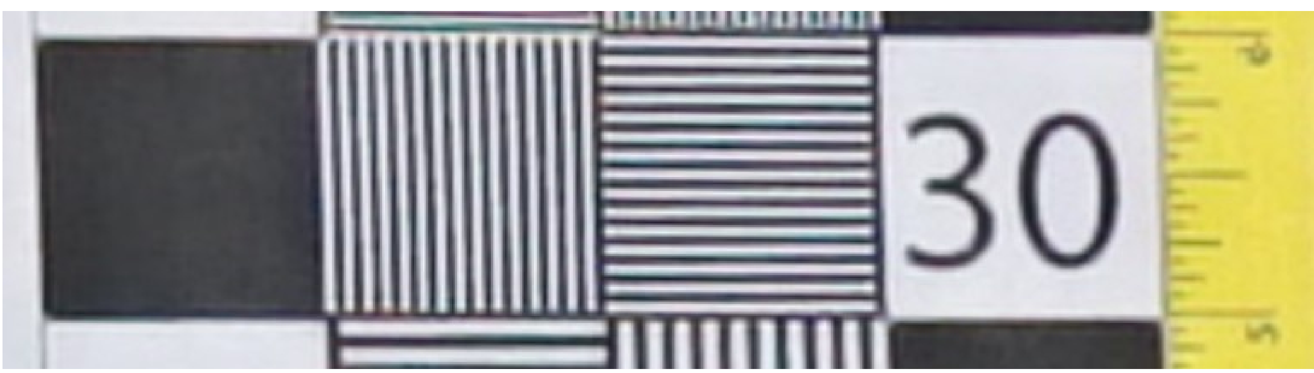


Figure 2-35 Closeup of the Resolution Test Target Which Signified 30 Lines in a 1"x1" Square

The significance of this test provided a quantitative way to discover how large a defect, such as a crack, would theoretically need to be to be discovered by means of a UAS imaging. This was done by finding the largest amount of lines in a square while still being distinguished or legible. The image below is an example between clear lines versus blurred ones.

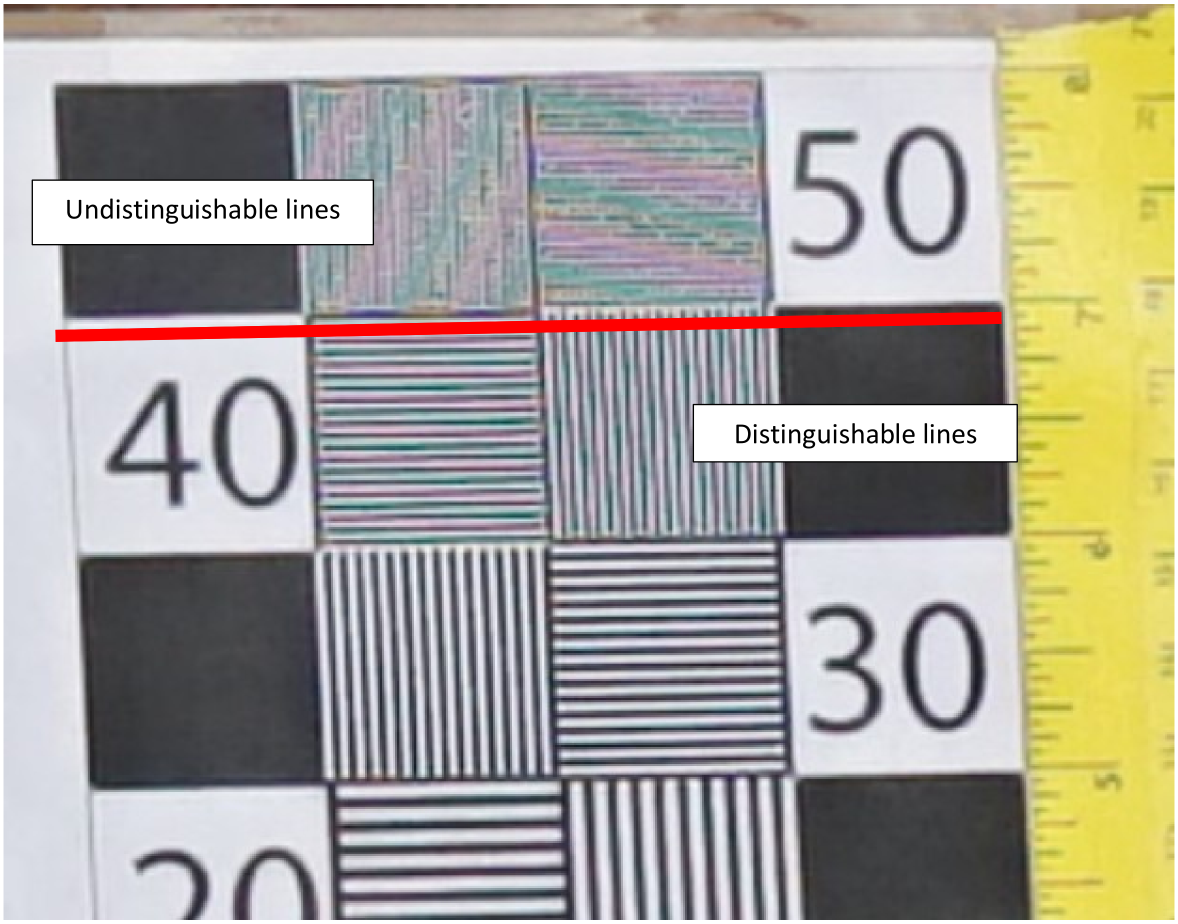
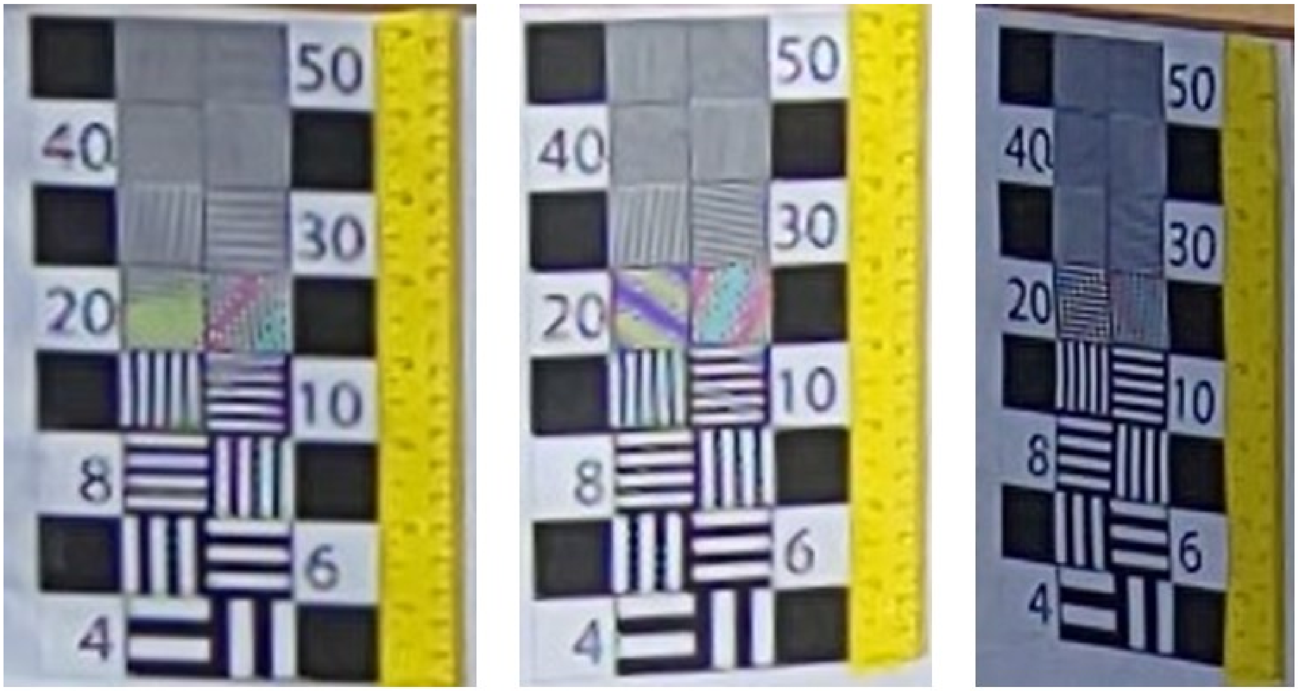


Figure 2-36 Example Showing the Difference Between Distinguished Lines and Undistinguished Lines (Separated by the Red Line)

There were three small target grids presented on the visual aid. Each target was oriented to specific angles relative to the direction normal to the camera lens. This simulated conditions where a drone could not provide a normal line of sight to the structure and resulted in a skewed photo angle. The angles chosen were 0°, 30°, & 60°.

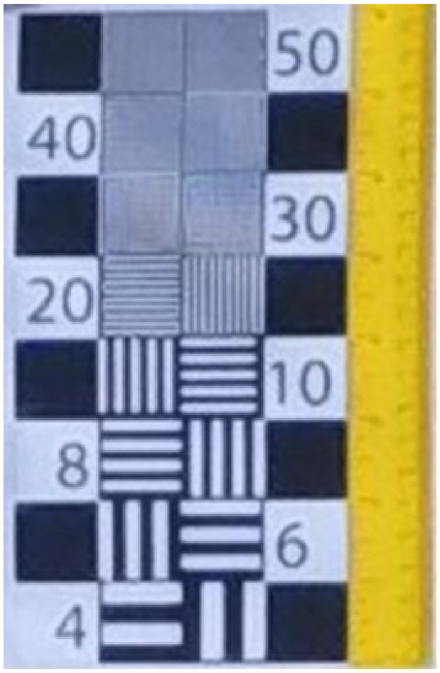
The first comparison at 10 feet resulted with the Skydio is shown below. At all skew angles, 20 lines per square were blurry and could not be counted. The largest amount of lines still able to be legible was 10 lines per one inch. This correlated to being able to detect a crack width of 0.1” at 10 feet away at any angle up to 60 degrees.



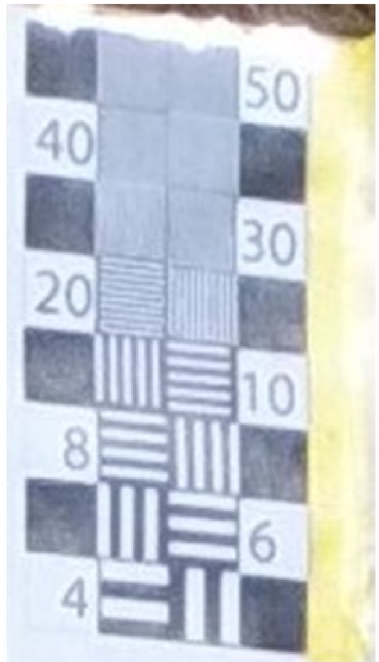
Skydio 10 FT at 0 degrees | **Skydio 10 FT at 30 degrees** | **Skydio 10 FT at 60 degrees**

Figure 2-30 Skydio Resolution Test at Several Angles From 10'

Another comparison at 10 feet was performed with the Anafi and is shown below. At all skew angles, 30 lines per square were blurry and could not be counted. The largest amount of lines still able to be legible was 20 lines per one inch. This correlated to being able to detect most crack widths of 0.05" or larger at 10 feet away at any angle up to 30 degrees. At 60 degrees, horizontal lines were still clear at 20 lines per inch with the vertical lines blurred until 10 lines per on inch. Therefore, at a 60-degree skew it would be understood that a horizontal crack of 0.05" or larger would be noticed although, a vertical crack would need to be 0.1" or larger to be noticed.



Anafi 10 FT at 0 degrees

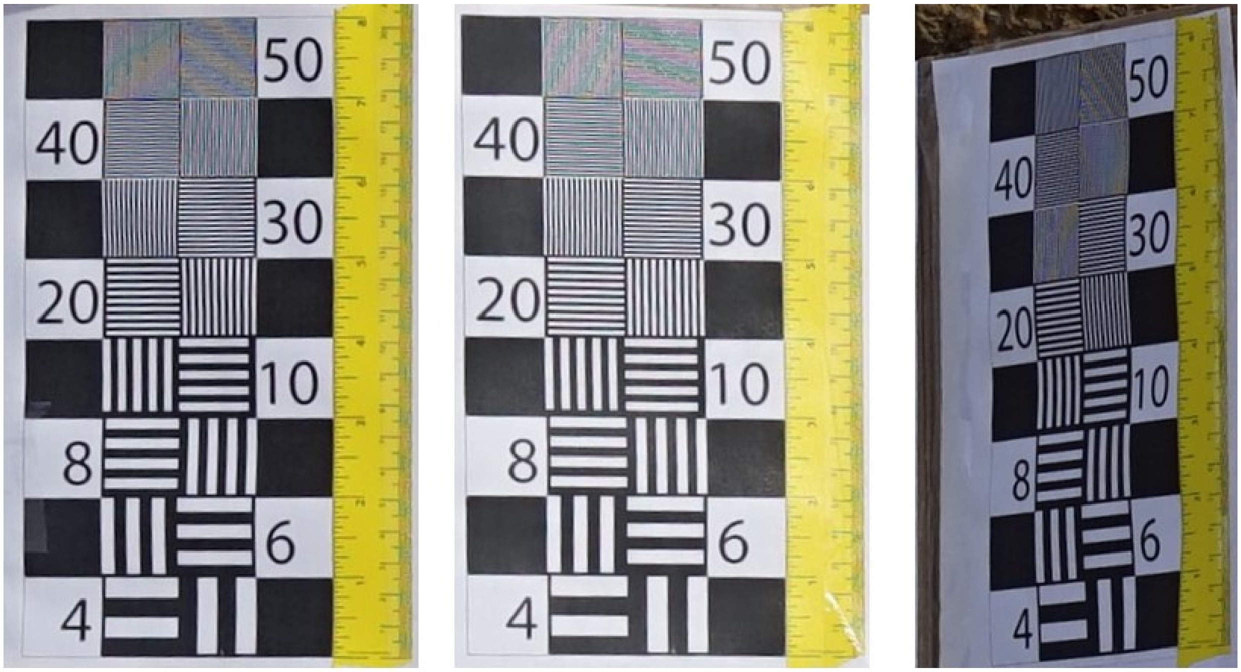


Anafi 10 FT at 30 degrees

Anafi 10 FT at 60 degrees

Figure 2-31 Anafi Resolution Test at Several Angles from 10'

The last comparison at 10 feet was performed with the Intel Falcon 8+ which is shown below. At all skew angles, 50 lines per square were blurry and could not be counted. The largest amount of lines still able to be legible was 40 lines per one inch. This correlated to being able to detect most crack widths of 0.025” or larger at 10 feet away at any angle up to 30 degrees. At 60 degrees, horizontal lines were clear up to the 40 lines per inch with the vertical lines blurred above 40 lines per inch while vertical lines only started to be visible at 20 lines per inch. At a 60-degree skew, it would be understood that a horizontal crack of 0.025” or larger would be noticed while vertical cracks would need to be 0.05” or larger to be noticed.



Intel Falcon 8+ 10 FT at 0 degrees

Intel Falcon 8+ 10 FT at 30 degrees

Intel Falcon 8+ 10 FT at 60 degrees

Figure 2-32 Intel Falcon 8+ Resolution Test at Several Angles From 10'

2.6.2.4 Field of View Test Results

The last comparison of the three cameras was the field of view (FOV) from the images. Images were compared at the 100-foot distance of the photos taken. The field of view is primarily a factor of the camera lens. The Skydio and Anafi both have fisheye lenses that creates a much larger FOV with a convex lens. When using a fisheye camera, the larger FOV collects on the same sensor, thus the resolution is decreased due to the condensed light waves. A large FOV can be very beneficial when figuring out where an image is in respect to the bridge or other members, but typically produces imagery that is not as clear when reviewing under digital zoom.

The Skydio image shown below has a relatively darker image when compared to the other two cameras. Of all three drones this had the widest shot which included more background and more of the adjacent piers to the target.

Figure 2-33 Skydio's Full Image at 100 Feet From the Visual Test Board

The Anafi Parrot also had a wider shot compared to the Intel and is shown below. Colors were the brightest on this camera. Detail was lost within the shadows when compared to the other images by the Intel and Skydio.

Figure 2-34 Anafi's Full Image at 100 Feet From the Visual Test Board

The Intel's camera is shown below, which had a noticeable narrower field of view. Also, colors observed in this were paler in contrast to the other camera images.

Figure 2-35 Intel Falcon 8+'s Full Image at 100 feet From the Visual Test Board

2.6.3 QR Code Distance Test with Pix4D Tagger

While Pix4D Tagger is an invaluable tool in processing, it has limitations. Like most instruments, if it is not used correctly, it may limit its effectiveness. The importance of having this knowledge could help minimize issues in processes by addressing concerns before starting the project. The first concern to be addressed was at what distance from the camera to a tag would render it ineffective. Understanding this dilemma would provide necessary information for the user to maximize their effectiveness out in the field and in the office when processing.

2.6.3.1 Procedure

A simple test was conducted to evaluate the effectiveness of the QR codes corresponding to its distance away from the camera. The test was performed under conditions at a site that would be considered typical in the field. The Intel Falcon 8+ was chosen to take the photos as it is predominately used on large and complex jobs like the Stone Arch Bridge located in Minneapolis, Minnesota.

The flight plan of the Intel Falcon 8+ was to take a photo starting at an altitude of 20 feet directly over the QR codes and capturing a photo every additional 20 feet up to the altitude of 140 feet. The screenshot below showcases the flight. Each green point represents the location where a photo was taken.

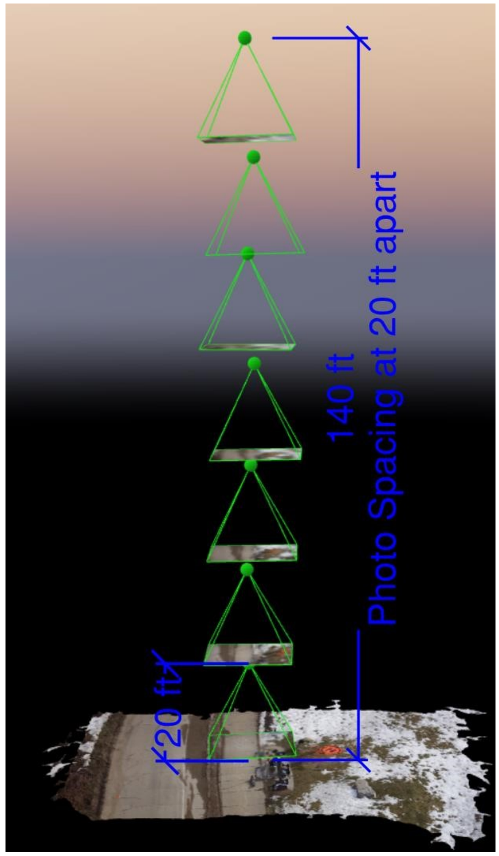


Figure 2-36 Pix4D Screenshot with the Locations Of Each Shot Taken During the Test

After the photos were taken in the field, the images were then modeled using Pix4D with the aid of Pix4D Tagger. After the first and second steps were completed, a visual analysis was done to compare percentage of QR codes lost due to distance and lack of resolution.

2.6.3.2 Results

Each tag was examined through the Basic GCP/MTP Editor. Through this editor, images were automatically color-coded notifying if the Pix4D Tagger recognized the QR code for the individual photo. A recognized QR code created four key points corresponding to the four corners of the unique code as described above. The figure below is a screenshot of how it was visually analyzed.

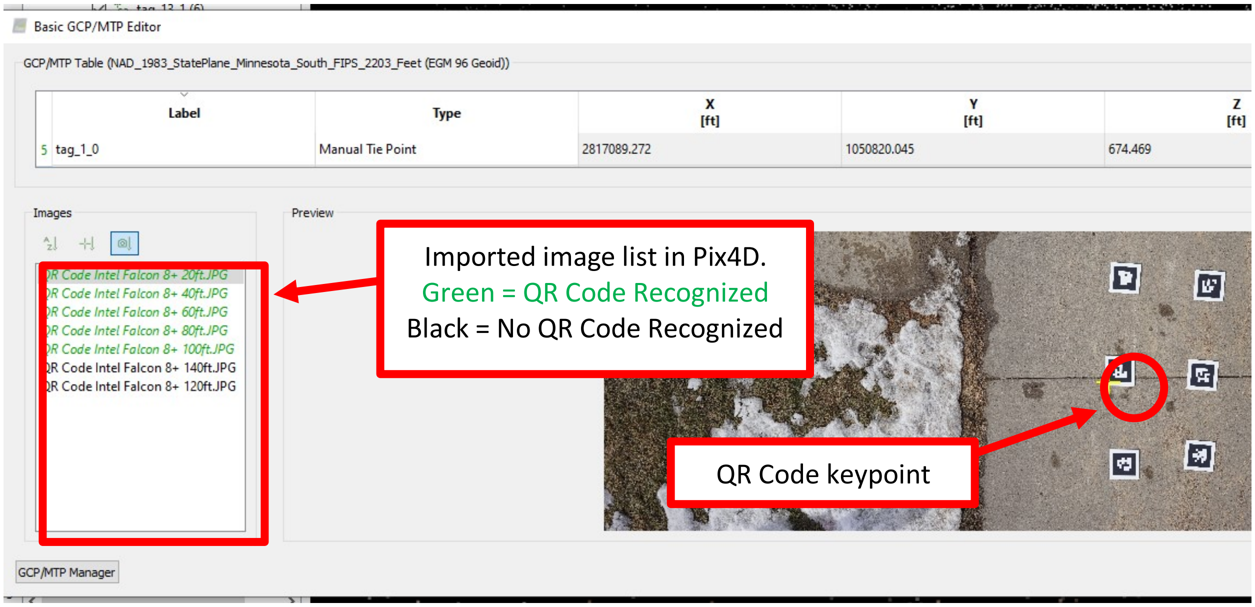


Figure 2-37 Pix4D Screenshot in Basic GCP/MTP Editor With Notes

Each tag was examined and results of each was noted. A summary of the results is shown below. If a QR code tag was recognized, a '1' was used, a '0' represented Pix4D not recognizing the code in the image.

Pix4D Tagger QR Code Recognition Summary							
QR code ID	**20 ft**	**40 ft**	**60 ft**	**80 ft**	**100 ft**	**120 ft**	**140 ft**
1	1	1	1	1	1	0	0
6	1	1	1	1	0	1	0
8	1	1	1	1	1	0	0
13	1	1	1	1	1	1	0
14	1	1	1	1	1	1	0
24	1	1	1	1	1	0	0
31	1	1	1	1	1	0	0
Percentage of matches per distance	100%	100%	100%	100%	86%	43%	0%

Figure 2-38 Pix4D Tagger Test Results

2.6.3.3 Conclusion

In summary, all QR codes were fully effective up until a distance above 80 feet. After 80 feet from the camera to the target, accuracy of recognition sharply dissipated. At 100 feet, the success rate of dropped to 86% while 120 feet resulted in 43% of targets recognized. Any QR code 140 feet away was ineffective and it would be reasonable to assume anything beyond this limit would also be ineffective. The chart below visualizes the results of the matches compared to the distance.

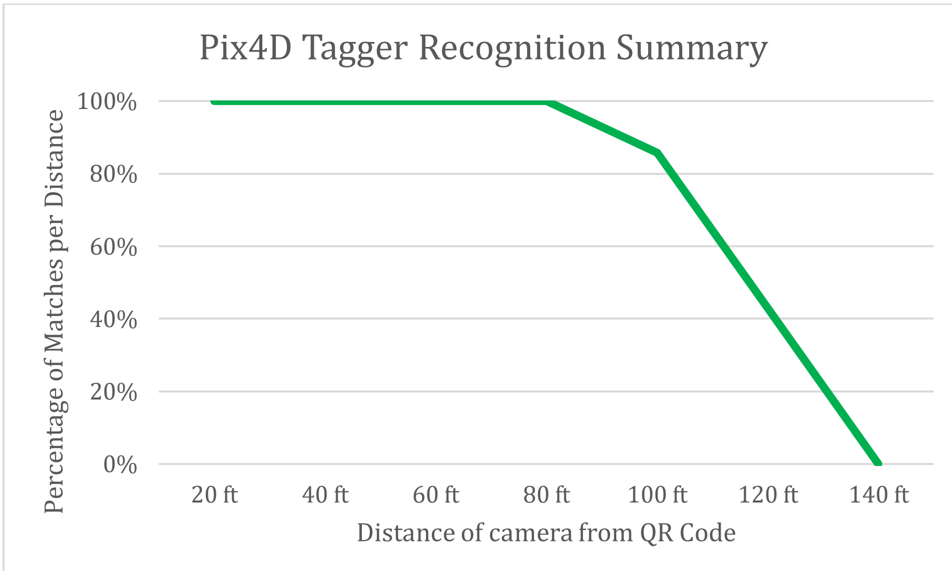


Figure 2-39 Chart Showing the Match Percentage Dropping After 80 Feet

2.6.3.4 Limitations

This test was helpful in providing a general understanding of the effectiveness for QR code with Pix4D Tagger relative to the distance of the camera to the QR code. While the test provided valuable insights there are some caveats to consider. These caveats include a variety in imaging devices, a comparison in QR Code sizing and material, angle of the photo relative to the tag, and more photos to compare. Further testing analysis could provide more awareness on how these variables may affect Pix4D Tagger with the focus of creating a superior product by efficient means.

2.6.4 Computer Processing Comparison

Phase IV tested the effectiveness of five different processors at running a model that was previously completed. With a higher photo count, the process will take longer to complete a model, so this test was to show the time required to complete the model using varying levels of processor. This test was completed using the software Pix4D on each computer. The five computer processors compared are as follows in highest to lowest processing power:

- Computer 1: Intel® Core™ i9-9980XE CPU @ 3.00GHz (36 CPUs) 3.00GHz
- Computer 2: Intel® Core™ i9-9900K CPU @ 3.6 GHz (16 CPUs) 3.6GHz

- Computer 3: Intel® Core™ i7-8850H CPU @ 2.60 GHz (12 CPUs) 2.6GHz
- Computer 4: Intel® Core™ i7-6820HK CPU @ 2.7GHz (8 CPUs) 2.7GHz
- Computer 5: Intel® Core™ I7-8650U CPU @ 1.90GHz (8 CPUs) 2.11 GHz

Each processor ran a model in Pix4d of a retaining wall that had 875 images to stitch together. Pix4D has two steps in creating a model. Step 1: Initial Processing and Step 2: Point Cloud Densification. To make each model run as smoothly and efficiently as possible, the model and the photos were saved onto the internal hard drive. This also made sure no failed internet connection interfered with the processing time. The Pix4D software produces a file called "Quality Report" which gives a detailed summary of what occurred to produce the model. The comparisons came from the details of this report. Below are images taken from the Pix4D Quality Report for each processor.

Summary

Project	MnDOT Retaining Wall R-156-003-010 (C)
Processed	2020-03-17 08:43:14
Camera Model Name(s)	ILCE-7R_FE35mmF2.8ZA_35.0_7360x4912 (RGB)
Average Ground Sampling Distance (GSD)	0.23 cm / 0.09 in
Time for Initial Processing (without report)	55m:54s

Quality Check

Images	median of 92459 keypoints per image	✓
Dataset	866 out of 875 images calibrated (98%), all images enabled	✓
Camera Optimization	1.02% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 14580.3 matches per calibrated image	✓
Georeferencing	yes, 10 GCPs (10 3D), mean RMS error = 0.008 ft	✓

Figure 2-40 Computer 1 Quality Report Step 1

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	01h:43m:05s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	26m:08s

Figure 2-41 Computer 1 Quality Report Step 2

Summary

Project	MnDOT Retaining Wall R-156-003-010 (C)
Processed	2020-03-18 16:55:58
Camera Model Name(s)	ILCE-7R_FE35mmF2.8ZA_35.0_7360x4912 (RGB)
Average Ground Sampling Distance (GSD)	0.23 cm / 0.09 in
Time for Initial Processing (without report)	43m:01s

Quality Check

Images	median of 92360 keypoints per image	✓
Dataset	863 out of 875 images calibrated (98%), all images enabled	✓
Camera Optimization	1.03% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 14648.9 matches per calibrated image	✓
Georeferencing	yes, 10 GCPs (10 3D), mean RMS error = 0.007 ft	✓

Figure 2-42 Computer 2 Quality Report Step 1

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	02h:19m:58s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	20m:42s

Figure 2-43 Computer 2 Quality Report Step 2

Summary

Project	MnDOT Retaining Wall R-156-003-010
Processed	2020-03-27 01:04:01
Camera Model Name(s)	ILCE-7R_FE35mmF2.8ZA_35.0_7360x4912 (RGB)
Average Ground Sampling Distance (GSD)	0.23 cm / 0.09 in
Time for Initial Processing (without report)	03h:09m:38s

Quality Check

Images	median of 92459 keypoints per image	✓
Dataset	868 out of 875 images calibrated (99%), all images enabled	✓
Camera Optimization	1.02% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 14613.6 matches per calibrated image	✓
Georeferencing	yes, 10 GCPs (10 3D), mean RMS error = 0.007 ft	✓

Figure 2-44 Computer 3 Quality Report Step 1

Processing Options

Image Scale	1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	04h:55m:25s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	25m:56s

Figure 2-45 Computer 3 Quality Report Step 2

Summary

Project	MnDOT Retaining Wall R-156-003-010 (C)
Processed	2020-03-13 16:39:13
Camera Model Name(s)	ILCE-7R_FE35mmF2.8ZA_35.0_7360x4912 (RGB)
Average Ground Sampling Distance (GSD)	0.23 cm / 0.09 in
Time for Initial Processing (without report)	02h:11m:34s

Quality Check

Images	median of 92439 keypoints per image	✓
Dataset	866 out of 875 images calibrated (98%), all images enabled	✓
Camera Optimization	1.02% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 14641.1 matches per calibrated image	✓
Georeferencing	yes, 10 GCPs (10 3D), mean RMS error = 0.008 ft	✓

Figure 2-46 Computer 4 Quality Report Step 1

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	13h:11m:45s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	31m:16s

Figure 2-47 Computer 4 Quality Report Step 2

Summary

Project	MnDOT Retaining Wall R-156-003-010
Processed	2020-03-17 22:30:46
Camera Model Name(s)	ILCE-7R_FE35mmF2.8ZA_35.0_7360x4912 (RGB)
Average Ground Sampling Distance (GSD)	0.23 cm / 0.09 in
Time for Initial Processing (without report)	1d:05h:50m:53s

Quality Check

Images	median of 92400 keypoints per image	✓
Dataset	862 out of 875 images calibrated (98%), all images enabled	✓
Camera Optimization	1.02% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 14683.1 matches per calibrated image	✓
Georeferencing	yes, 10 GCPs (10 3D), mean RMS error = 0.007 ft	✓

Figure 2-48 Computer 5 Quality Report Step 1

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	09h:12m:10s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	36m:19s

Figure 2-49 Computer 5 Quality Report Step 2

From the quality reports above, the following information was compiled to allow an easy comparison between each of the processors. This comparison is shown in the table below:

Computer	1	2	3	4	5
Processor	Intel® Core™ i9-9980XE CPU @ 3.00GHz (36 CPUs) 3.00GHz	Intel® Core™ i9-9900K CPU @ 3.6 GHz (16 CPUs) 3.6GHz	Intel® Core™ i7-8750H CPU @ 2.20 GHz (12 CPUs) 2.2GHz	Intel® Core™ i7-6820HK CPU @ 2.7GHz (8 CPUs) 2.7GHz	Intel® Core™ I7-8650U CPU @ 1.90GHz (8 CPUs) 2.11 GHz
Ram	64GB	64GB	32 GB	64GB	16 GB
System Type	64 bit	64 bit	64 Bit	64 bit	64 bit
Graphics	Nvidia Geforce RTX 2080 Ti	Nvidia Geforce RTX 2080 Ti	Intel® UHD Graphics 630	Nvidia Geforce GTX 1070	Intel® UHD Graphics 620
Onboard Storage	953 GB	930 GB	475 GB	475 GB	475 GB
Step 1 Process Time	55m54s	43m01s	3h09m38s	2h11m34s	1d05h50m53s
Point Cloud Time	1h43m05s	2h19m58s	4h55m25s	13h11m45s	9h12m19s
3D texture Time	26m08s	20m42s	25m56s	31m16s	36m19s
Total Time	3h05m07s	3h23m41s	8h30m59s	15h54m35s	1d14h54m31s
Images Calibrated	866 of 875	863 of 875	868 of 875	866 of 875	862 of 875

Figure 2-50 Table of Computing Power Processing Test Results

The processing time correlates to the processing power. The higher the power, the faster the computer was able to create the model. Referring to the table above, we can identify that this model took a maximum of 1 day 14 hours 54 minutes 31 seconds, and a minimum of 3 hours 5 minutes and 7 seconds. The difference in time shows that a higher-powered processor is the optimum configuration when creating models.

CHAPTER 3: BRIDGE LIST CANDIDATE SELECTION

3.1 SELECTION CRITERIA

A bridge list was developed for bridges that would benefit from drone inspections based on parameters conducive to UAS inspections. All bridges in the MnDOT Metro District were ranked based on the following five factors:

<u>Feature Intersected</u>

Bridges over waterways are more conducive to UAS applications because the drone is less likely to fly over traffic. Bridges over waterways score 20 points and bridges over roadways is 0 points; however, new proposed rulemaking by the FAA will allow more flights over traffic. An additional score has been calculated to show how the scores and rankings will change when this new rule is in place. This new score ignores the feature intersected. The new rulemaking will dramatically increase the number of bridges eligible for a UAS inspection implementation.

<u>Average Daily Traffic (ADT)</u>

Bridges with ADT of less than 5000 score 20 points, ADT of less than 20000 score 10 points and ADT over 20000 score 0 points.

<u>Bridge Type</u>

With a focus on utilizing the Elios drone for confined space, bridges that could be inspected with the Elios score 20 points, and other bridges score 0 points.

<u>Previous Successful UAS Inspection</u>

Bridges that have previously been successfully inspected utilizing UAS score 25 points, and other bridges score 0 points.

<u>National Bridge Inspection (NBI) Ratings</u>

The use of UAS gives inspectors the ability to collect more data that is higher quality. This score awards 25 points for an average NBI of less than 6, an average NBI of between 7 and 8 receives 10 points, and an NBI of 9 scores 0 points.

3.2 IMPLEMENTATION

The bridges were sorted by score with higher scores representing bridges that would more likely benefit from UAS inspection, both from a risk and benefit standpoint. Several of the bridges on the list were inspected as part of this project and results can be found in Chapter 4 of this report. This list can be used in the future to help identify bridges that can be inspected by the Elios drone or the new drones purchased by MnDOT which will be coming online soon.. The final sorted bridge list can be found in Appendix B.

CHAPTER 4: UAS IMPLEMENTATION IN THE FIELD

Several case studies are presented below demonstrating different applications for utilizing UAS on bridge inspections. These efforts were included as part of this study, as well as part of inspection projects. The UAS results were incorporated into the bridge inspection record.

4.1 ST. CROIX CROSSING BRIDGE

This case study consists of the results of an UAS bridge modeling and defect mapping of St. Croix Crossing bridge number 82045, TH 36 over St. Croix River in Oak Park Heights, Minnesota. The section of bridge modeled for this phase was unit 3. Unit 3 is a 6-span, extradosed cable-stayed, post-tensioned concrete box girder unit spanning a total length of 3,365 feet between Piers 7 and 13. The unit is comprised of parallel precast box girder segments and carries the two lanes and shoulders of west and eastbound TH 36 and a 12-foot wide barrier-separated trail on the north side of the bridge. Transverse post-tensioning is located at each deck level with cable-stay anchorage. Loads are transferred from the interior box girder webs to the cable-stays. A catwalk is present along the full length of the unit along the bridge centerline. The typical unit width is 98’-6” out-to-out with a depth of 18’ throughout.

Figure 4-1 St. Croix Crossing Bridge

4.1.1 UAS Operation

A two-person crew, consisting of a professional engineer-pilot and a field engineer conducted the UAS inspection. The pilot was certified as a FAA Remote Pilot. The inspection was conducted using a registered UAS and several AeroPoints. The UAS was an Intel Falcon 8+ equipped with a Sony Alpha 7R camera and the majority of flight missions were preplanned using Intel Mission Control software.

During the inspection, the pilot flew the UAS and had direct line of sight and headset communication with the other crew members who also maintained line-of-sight of the UAS. The photos were taken in four sections: Fascia, Deck, Underside, and Piers to achieve a high-resolution 3D model of the bridge. Deck and fascia sections had a preplanned mission to allow for an accurate overlap of each photo of approximately 85 percent. Underside and pier section photos were taken using manual flight control. All photos were taken in a systematic overlapping manner to ensure total photo coverage of the bridge.

4.1.2 Mission Scope

UAS was utilized for two main purposes for this bridge inspection: for planning the inspection and for executing the actual inspection.

Two weeks prior to the inspection, the entire bridge was flown from an altitude of 100 feet and 1200 images were collected. This data was post processed in Pix4D to create a model and a map. Both were used to plan the inspection and provided a visual tool to communicate this plan with a large team of inspectors. The inspection plan map delineated the substructure and span numbers, meeting areas, muster and manhole access locations. The plan was used in the field from phones and tablets to monitor progress and to orient inspectors to their location on the bridge.

Figure 4-2 St. Croix Crossing Bridge Inspection Planning Map

Mapping missions were performed of all the main spans of the bridge using the Falcon 8+ UAS to explore the potential of UAS imaging including:

- the ability to map the entire large-scale bridge
- the difference in quality of a UAS and terrestrial inspections
- the applicability of a 3D model in assisting an inspection team during an in-depth inspection with areas of difficult accessibility

The Falcon 8+ efficiently captured a series photographs to use to map the bridge deck and to create a post-inspection tool to aid in repair plans, quantity estimation and historical documentation. The last in-depth inspection that was conducted was used as a control to compare the outcome of the UAS mapped post-inspected bridge. A total of 5,670 images were taken and collected with autonomous flights preprogrammed with Intel's Mission Control Software. Images were collected of the underside of the bridge by placing the Intel drone on the boat and manually triggering photos as the boat was driven around underneath the bridge.

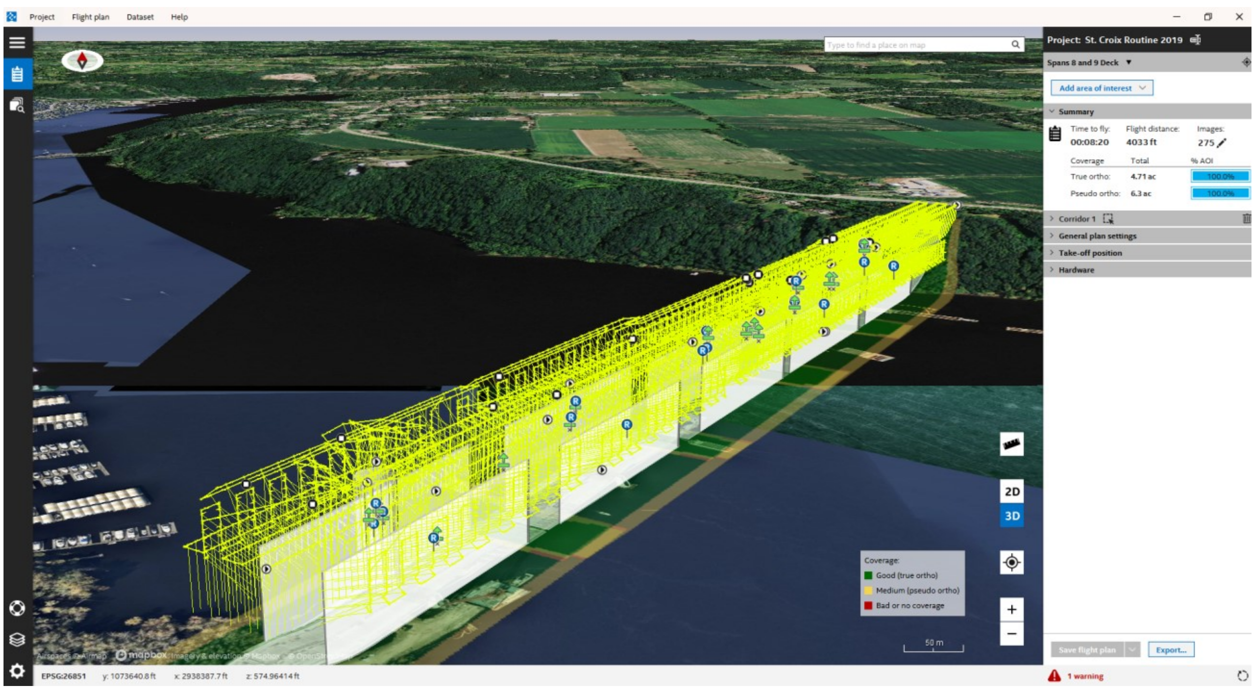


Figure 4-3 St. Croix Crossing Bridge Flight Plans

4.1.3 Deliverables

A 3D Model with a High-Resolution Photograph Log was processed from the flights. All photographs taken during the Mapping Missions were processed in the Pix4D software. The software processed photographs to form a 3D point cloud for digital viewing. The point cloud was then processed by the same software to generate a 3D mesh of the bridge.

An inspector was able to use the Pix4D program to navigate the 3D model and select areas of interest. The software provided the inspector with all still images containing the selected area of interest which can then be viewed in high resolution. Additionally, the inspector could place annotations and measurements areas into the model for design plans, further detailed inspection, or construction documents.

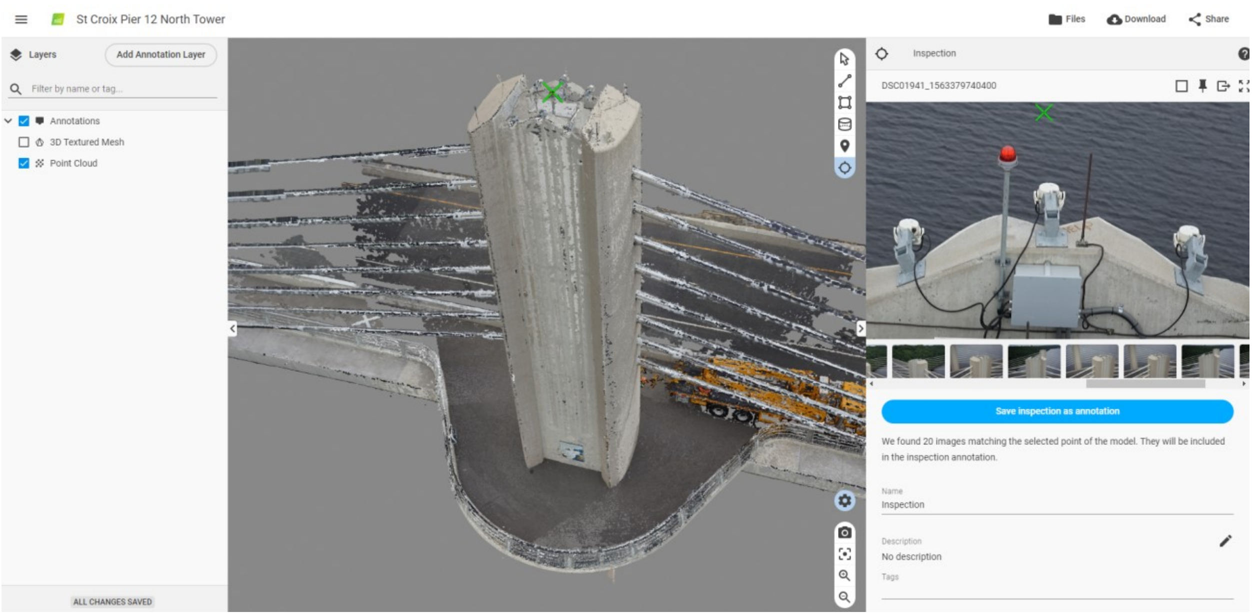


Figure 4-4 St. Croix Crossing Bridge 3D Photolog

4.1.4 Findings

4.1.4.1 Opportunities

The execution of the Mapping and Photogrammetry Mission was a success and provided great insight into the potential of UAS as a tool during in-depth inspections. The set-up, flight, and data generation went as planned. The Falcon 8+ UAS performed well and demonstrated to be a cost effective and efficient way to inspect areas of a bridge that were difficult to access. The use of UAS would reduce the high cost of traditional access equipment, produce an accurate account of defect quantities at the time of inspection, and the data gathered was substantial enough to create the planned deliverables. The deliverables demonstrated that significant improvements can be made in inspection documentation utilizing photogrammetry techniques. Defect measurement was more accurate and easier to share with the bridge owner.

4.1.4.2 Limitations

While the Falcon 8+ has a high-resolution camera onboard, some photos were too blurry to process. This issue was due to UAS movement and slow camera shutter speeds. The quality and settings of the camera on the UAS dictate how the pilot should fly a mission and the pilot needs an intimate understanding of the operating environment and UAS settings. If the UAS has a lower quality camera, it will need to be flown closer to the bridge and require more photos to produce the same model. Flight time is an issue that must be factored in and planned for. For the Falcon 8+, there are two batteries that will allow a maximum flight time of roughly eighteen minutes. After the images have been taken and are put into a modeling software, the number of photos and the processing power of the computer drives the time it takes to process the bridge. After the initial process is completed, the model has the potential of needing manual editing to produce an accurate reality model.

4.1.4.3 Conclusion

The use of UAS for the bridge safety inspection of the St. Croix Bridge was invaluable to creating a higher quality deliverable, saving time and resources, and creating a safer working environment. Although not all elements or components can or should be inspected with the drone, the use of a UAS under preplanned missions could replace the need for certain aerial access platforms, rope access requirements, or other hazardous or high-risk operations.

4.2 I-394 @ DUNWOODY ON AND OFF RAMPS

This field inspection implementation consisted of UAS imaging and terrestrial radio-controlled imaging in the routine inspection, element condition assessment, and defect mapping of several interior boxes and exterior elements at bridge number 27831C and 27831D, I 394 over Dunwoody Blvd. in Minneapolis, Minnesota. The bridges were inspected, and a study was conducted of the RC/UAS Inspection for the Minnesota Department of Transportation (MnDOT) in June-November 2019 as part of Phase IV.

Bridge 27831C is a westbound I-394 on ramp from I-94 near downtown Minneapolis. This structure is comprised of five prestressed concrete beam spans and four concrete box girder spans supported by reinforced concrete caps with reinforced concrete columns.

Bridge 27831D is an eastbound I-394 off ramp to I-94 near downtown Minneapolis. The structure is comprised of five prestressed concrete beam spans and four concrete box girder spans supported by reinforced concrete caps with reinforced concrete columns.

4.2.1 Mission Scope

A mapping mission using the Parrot Anafi was identified to explore the potential of UAS photography to map concrete deck wearing surface defects. Primary goals of the missions included:

- Gather information in the form of photographs in a quick, efficient process that could later be used to map the deck wearing surface deficiencies
- Create a post-inspection tool to aid in repair plans, quantity estimation and historical documentation
- Eliminate the need for lane closures
- Explore the effectiveness of thermal imaging

Most of the Dunwoody bridge's 'On and Off' ramps were selected for imaging. The Parrot Anafi was flown using manual flight missions parallel to the ramp on an offset of approximately 30 feet from the outside railing with an elevation of the same distance above ground level. These parallel runs were done only on one side of each ramp without being directly over any traffic.

A high definition video mission was also conducted of limited access areas using the collision tolerant Elios UAS. Primary goals of this mission included:

- Determine the quality and applicability of using a Collision-Tolerant UAS to capture images
- Assess the condition of bridge pier cap topsides, end diaphragms and bearing elements which typically are difficult and costly to access and not easily viewed during a routine inspection
- Test the UASs' flight quality in open-air environments

The mission consisted of several interactive flights using only pilot controls. The use of the Elios UAS focused on these hard to access locations. An inspector then reviewed the video footage for defects and findings.

A two-person crew, consisting of a professional engineer-pilot and a field engineer conducted the UAS inspection. The pilot was certified as a FAA Remote Pilot. During the inspection the pilot worked with a mobile controller and the other crew member maintained a line-of-sight with the UAS. Flights that were conducted under the bridge deck and in the box girders hindered the GPS connection, meaning the flight was conducted in interactive GPS denied mode. The bridge was located in Class G Airspace therefore, no FAA waiver or additional authorization was necessary.

Several additional missions using terrestrial cameras mounted on a Remote Control (RC) platform were identified for this bridge to explore the potential of terrestrial photography to map concrete box girder interior defects. The target goal of the mission was to explore the difference in quality between UASs and terrestrial photography in confined spaces. The imaging of all boxes for bridge numbers 27831C and 27831D were selected for imaging using terrestrial means and cell DE1 from Bridge 27831C was selected for UAS means. The Flyability Elios was selected for the UAS method. The small confined space had limited effectiveness using the UAS due to the high dust levels. The terrestrial method utilized four GoPro Hero 7 High-Resolution Cameras mounted in a cluster on the RC device and orientated in different directions (up, down, left, and right). Images were taken simultaneously from all cameras at calibrated distances from the RC device. The cameras were equipped with a 12 Megapixel still camera and a fisheye lens. During the inspection, the driver worked with a mobile controller while the other crew members monitored hazards and maintained communication in the confined space for the occupant(s). The entirety of terrestrial imaging was conducted inside the box girder spans. The number of images ranged from 100-350 per box depending on the size of the individual cells.

Figure 4-5 RC Imaging Platform with GoPro Camera Cluster

4.2.2 Deliverables

The use of UASs provided adequate visuals of areas with limited access such as the elements above the pier caps. This eliminated the need to utilize expensive access equipment during the routine inspection. The videos were then analyzed with Flyability Inspector software to highlight any points of interests in the video and provide heading orientation and altitude relative to launch location. The image below highlights the Flyability Inspector program:

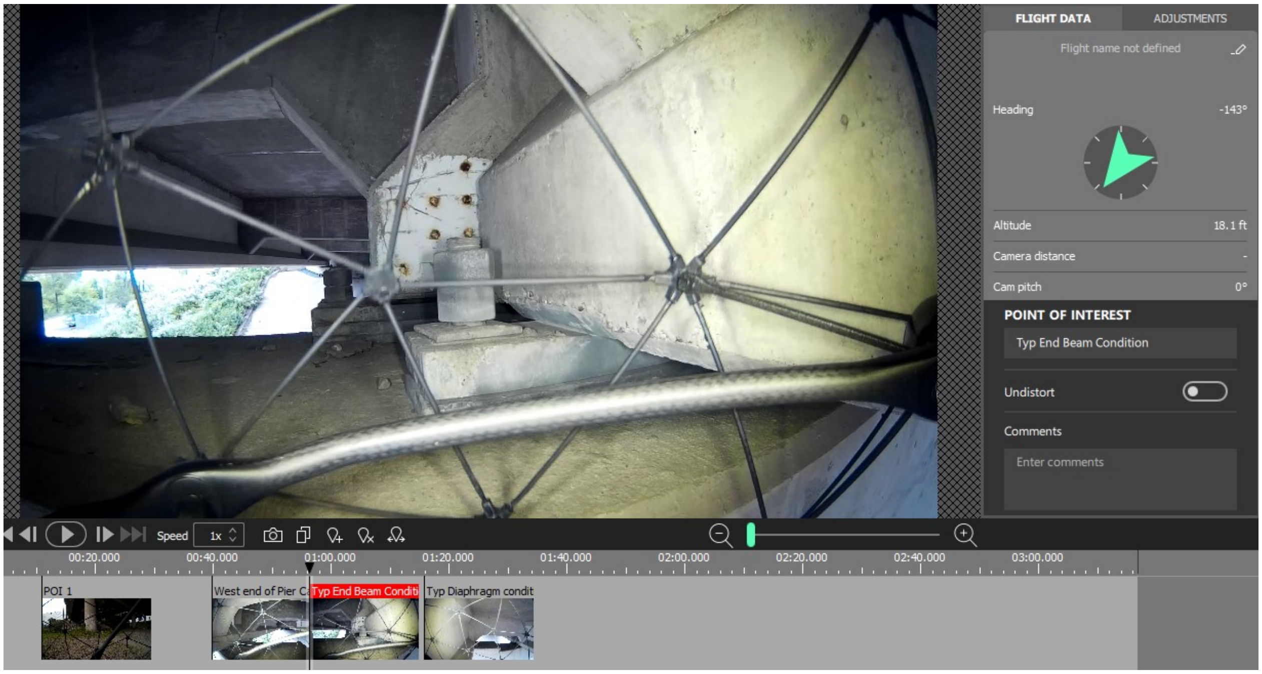
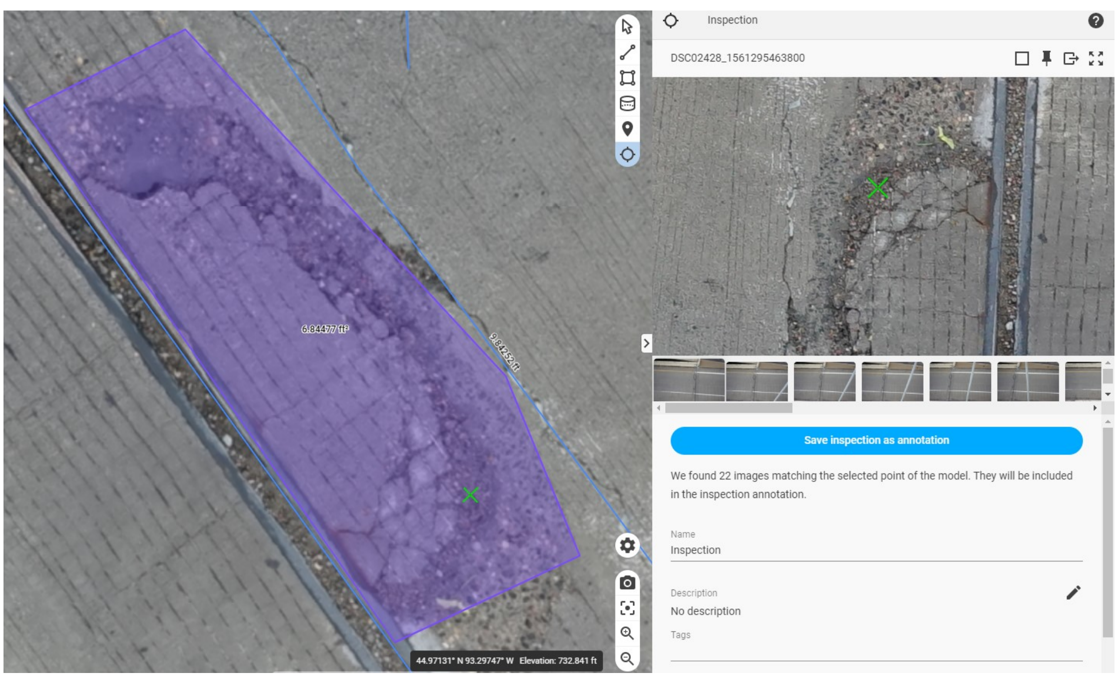


Figure 4-6 Flyability Inspector Screenshot.

A second use of UASs provided inspectors the ability to produce an othromosaic map of the deck with the Pix4D program. These models were uploaded to the cloud and the inspector placed annotations and measurements on any deficiencies found in the model. If there was a specific area of interest, the inspector could click the area, and the software would provide all the still images affiliated with its annotations showing the original pictures of the area of interest. Refer to Figure 4-7 and Figure 4-8 for an example of a deck with inspection notes and annotations.

Figure 4-7 Bridge 27831A Deck with Measurements in Pix4D Cloud



A
3D

Figure 4-8 27831A Deck using the Inspector Mode in Pix4D Cloud

Additional models were created in Pix4D software for all interior boxes from the terrestrial imaging missions. These models provided a visually representation the current condition of the boxes within a virtual interactive environment, allowing for future comparisons. The models could be simplified further into 2D orthomosaics where deficiencies could easily be traced electronically, shown below. Some limitations included time to figure out a proper process for correct imaging and increased processing time required to refine or rectify the final product for some models.

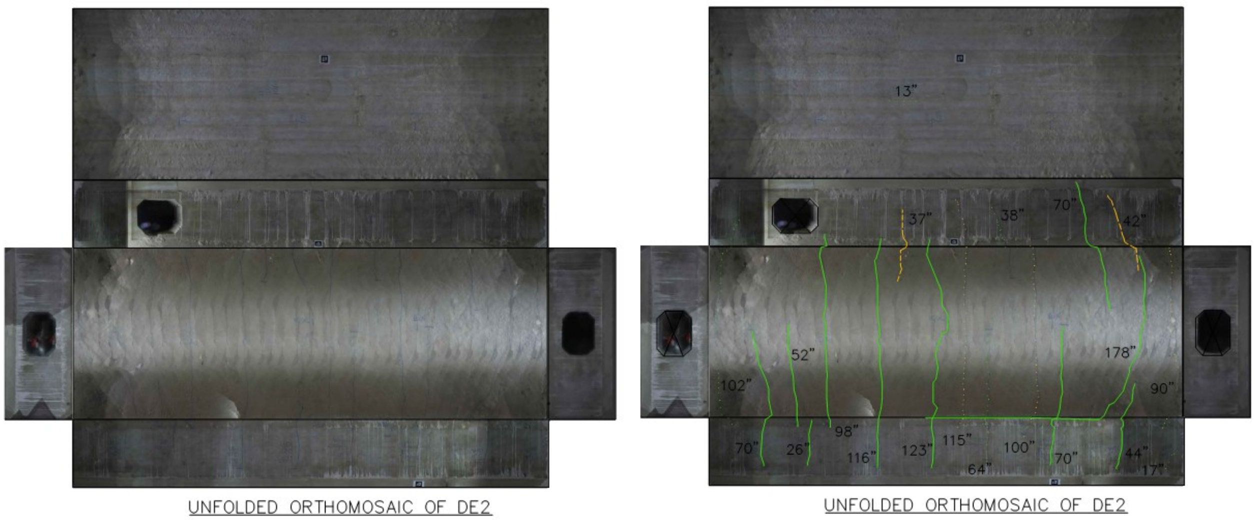


Figure 4-9 Unfolded Views of a Box Girder Model, Left Being Untraced and the Right Traced

Figure 4-10 3D Model of a Cell

4.2.3 Findings

4.2.3.1 Advantages

The execution of the Mapping and UAS Mission was successful and provided great insight into the potential for UAS as a tool during routine inspections. The set-up, flight, and data generation went as planned and was substantial enough to create the planned deliverables. The deliverables demonstrated that significant improvements were made to the inspection documentation. Defect measurements were more accurate, simple to gather, and easier to share with the bridge owner.

The Elios collision tolerant drone performed well and demonstrated a cost effective and efficient way to inspect bearings and top of pier caps. These elements were typically not accessed during routine inspections before due to the high cost of access equipment, and the ability to get access equipment into these locations without expensive lane closures.

Photogrammetry methods using terrestrial devices proved to be beneficial for field work as it eliminated much of the necessary field documentation which translated to less time for engineers to spend inside confined space. This method also helped for post-inspection evaluation giving the inspector an effective way to accurately translate defects and measurements for future monitoring.

4.2.3.2 Limitations

While the collision tolerant drone video is not as reliable as a hands-on inspection, most of the components near the top of the pier are not being accessed at close range due to the high cost of inspection equipment and the ability to get access equipment into place easily. The collision tolerant drone also had limited effectiveness in the confined spaces of the boxes because of the high amount of dust that has accumulated there in combination with very tight vertical clearances.

The thermal implementation of the deck was difficult to showcase any potential areas of delaminations. Further site investigation would be needed to confirm any areas that were of concern for confidence in accurate information. Refer to the image below for a snapshot of the deck under the thermal camera. Additional exploration of the thermal capabilities and settings would need to be explored to implement this technology on a large scale with engineering confidence.

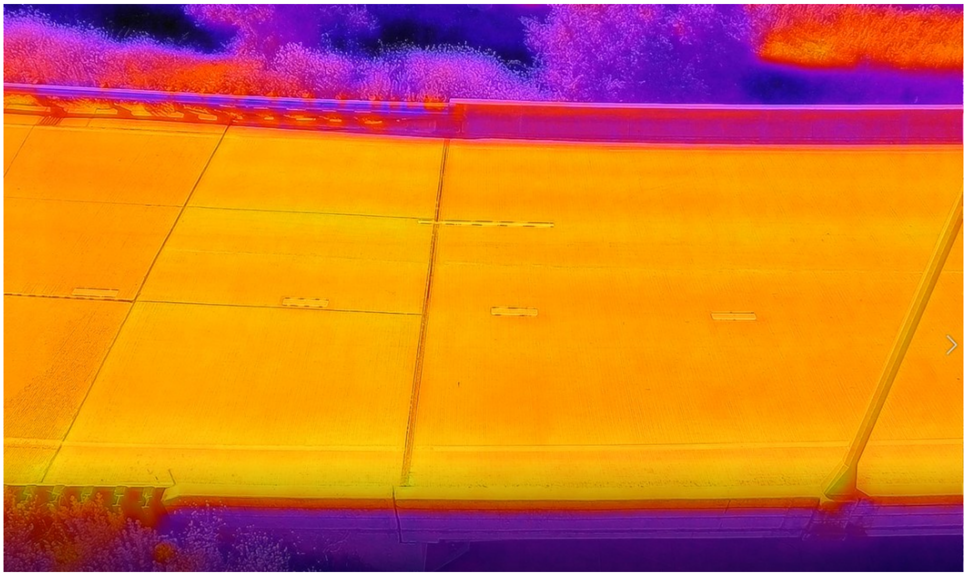


Figure 4-11 Thermal Snapshot of a Dunwoody Bridge Deck

The terrestrial method inside the box girders was not able to navigate through diaphragms without aid from the driver. The lack of light also proved to be troublesome which required lighting from 2400 Lumen portable lights lengthening set-up time for each cell. Since the box girder bridges were split into 48 cells per bridge, set-up times had a large impact in labor hours.

4.3 BLATNIK BRIDGE 9030 INSPECTION

This implementation consisted of unmanned aircraft system (UAS) inspection and element condition assessment of the Blatnik Bridge in conjunction with the routine and fracture critical inspection performed by Collins Engineers for WisDOT and MnDOT. The primary purpose was to utilize UASs to provide an inspection 3D model of the bridge with images georeferenced for documentation of the bridge conditions.

The Blatnik Bridge crosses Saint Louis Bay between Duluth, Minnesota and Superior, Wisconsin. The bridge is a steel through arch truss bridge and was originally constructed in 1961 and widened in 1992.

Figure 4-12 Overall Photo of the Blatnik Bridge

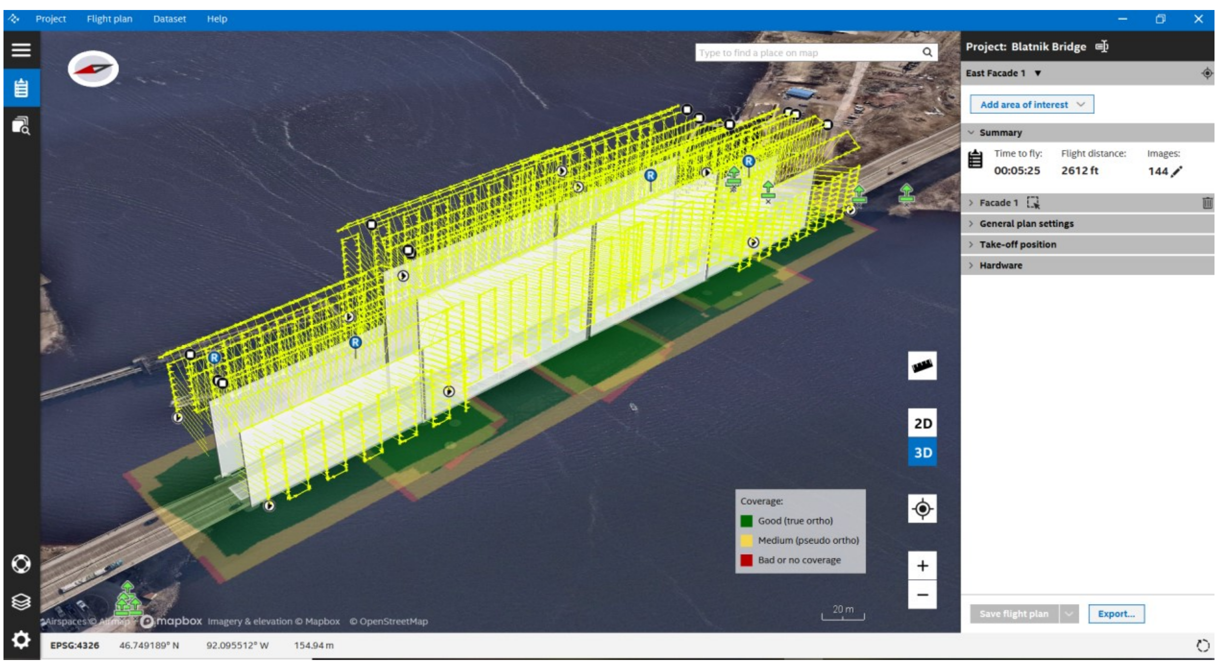


Figure 4-13 Preplanned Flights of the Blatnik Bridge

4.3.1 Mission Scope

Collins Engineers performed the routine and fracture critical inspection of the Blatnik Bridge as part of the FHWA bridge safety inspection requirements. As part of this project, the team utilized UAS to collect bridge inspection data. The UAS was not intended to replace the arm's length inspection but to supplement the inspection and communicate inspection results.

The UAS inspection was conducted using the Intel Falcon 8+ equipped with a Sony Alpha 7R camera. The missions were preplanned using Intel's Mission Control software. During the inspection, the pilot worked with a mobile controller and the other crew member-maintained line-of-sight with the UAS. In order to achieve a high-resolution 3D model of the bridge, flights were conducted manually using a pre-planned flight to allow for a more accurate overlap of each photo of approximately 85 percent. Flights were performed from the corners underneath the bridge. AeroPoint automatic ground control targets were placed on the bridge deck and on the piers near the waterline to geolocate the deliverables. The bottom of the bridge was covered by using a boat to drive patterns under the bridge while images were triggered manually. The entire data collection effort took less than 8 hours with a crew comprised of two bridge engineers.

Figure 4-14 Aerial View of the Intel Drone Collecting Data

Figure 4-15 Intel Drone Collecting Data

4.3.2 Deliverables

A 3D Model was generated in Pix4D software of the truss spans of the bridge. The models were generated locally on a high-end desktop computer and uploaded to the cloud using Pix4D's cloud platform. The models provided a way to communicate visually the current condition with a virtual interactive environment and provide means for future comparisons. The virtual inspection tool from Pix4D allowed the user to click on an area of interest and see the corresponding high-definition images of that area sorted by shortest distance to the object. Inspection notes can be added which are geolocated and linked to a specific image. The model was also used to annotate measurements of the bridge in addition to bridge labels and truss panel points.

Figure 4-16 Pix4D Cloud Data for the Blatnik Bridge

4.3.3 Findings

4.3.3.1 Advantages

The execution of the modeling with the Intel Falcon 8+ in combination with Pix4D software was successful and provided a very useful way to document the conditions of the bridge. The set-up, flight, and data generation went as planned and was substantial enough to create the planned deliverables. The deliverables demonstrated that significant improvements were made to the inspection documentation. Defect measurement was accurate, simple to gather, and easier to share with the bridge owner.

The preplanned missions from the Intel Software can be used in the future to collect the same data from the same locations and will offer a direct comparison of any deterioration between inspection cycles.

4.3.3.2 Limitations

Minor limitations were presented when acquiring the data in the field. One limitation was that a large bridge can be difficult to model. Some portions of the bridge model were not initially complete and manual tie points were needed to accurately depict the bridge. QR codes should be used on future inspections to eliminate the need to manually add tie points to save time in processing. These codes could potentially be installed on the bridge for future inspections.

4.4 SHV BRIDGE

This UAS implementation consists as a supplement to a special hauling vehicle (SHV) condition, load rating assessments, and defect mapping of culverts in Minnesota. The primary purpose during the inspection was to document and record actual conditions efficiently, rather than the typical, time consuming technique of documenting via paper and pencil. A variety of bridges included in this UAS field work were selected across the state of Minnesota. Structures were culverts consisting of a flexible corrugated metal pipe arch on top of short masonry walls and timber box culverts.

A two-person crew, consisting of a professional engineer-pilot and a field engineer, conducted the UAS inspection. The pilot was certified as a FAA Remote Pilot. The inspection was conducted using a Parrot Anafi Thermal UAS. During the inspection, the pilot worked with a mobile controller and the other crew members maintained line-of-sight with the UAS. The bridges were located in class G airspace therefore, no FAA waiver or additional authorization was necessary. In addition to the UAS, terrestrial imagery was used to capture photographs inside the confined corridor of the interior of the culverts. The camera utilized was an Olympus Tough TG-6 Waterproof Digital Camera.

4.4.1 Mission Scope

A mission using the Parrot Anafi was identified to implement UAS photography to image an isolated area of the timber culvert. The target goal of the mission was to gather information in the form of photographs in a quick, efficient process. These could later be used to document and measure existing deficiencies and have a post-inspection tool to aid in repair plans, quantity estimation and historical documentation. This mission eliminated the need for a full-scale model as it was only an isolated area. The inlet area of the culture was selected for imaging due to the washout and erosion present there. The Parrot Anafi was flown using manual flight in a half circle around the inlet on two different altitudes and distance from the culvert. The flight was conducted without being directly over any traffic.

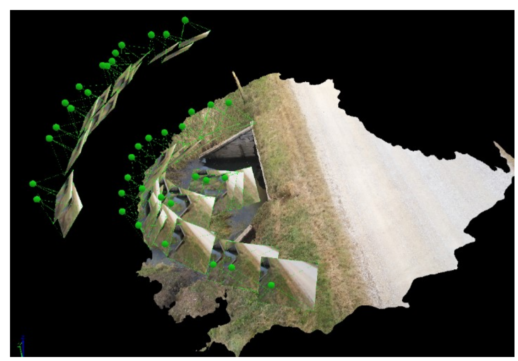


Figure 4-17 Timber Culvert Imaging Flight Path

An additional mission was performed using a terrestrial camera to explore the opportunity to model and document deflection of metal pipe culverts. The target goal of the mission was to explore the quality in terrestrial photography in a confined corridor. The imaging of the corrugated metal pipe arch bridge, number 88883 was selected for imaging using terrestrial means. The method used a point and shoot camera that represented most field photography devices used during general inspections. To begin, images were taken of both inlet and outlet with adequate overlap of the subject. Then photos were strategically spaced out from the same angle as the inspector walked through the barrel. The process of walking through while taking pictures was repeated several times, back and forth with the camera at different angles. The number of images totaled 257.

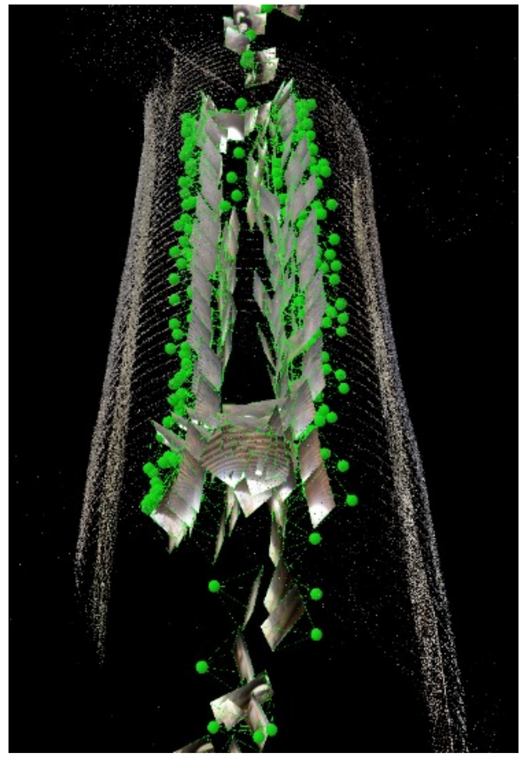


Figure 4-18 Metal Pipe Arch Interior Model Imaging Path

4.4.2 Deliverables

A 3D Model was processed in Pix4D software for the SHV bridge inspections presented above. The models created a virtual interactive environment with the ability to visually inspect current conditions, and allow for future comparisons, measurements, and documentation of condition assessment and load rating. The models also could be broken down into 2D orthomosaics where deficiencies could be easily traced and measured electronically.

The use of UASs provided adequate visuals for areas of concern efficiently with the ability for the inspector to obtain multiple photos that would reflect the best view of the deficiency as possible. The washout of Bridge 92460 was modeled at the inlet side of the culvert with the Anafi UAS. This gave insight on being more efficient with this tool by only implementing modeling on specific areas of concern. The image below represents the overall elevation view of the timber structure.

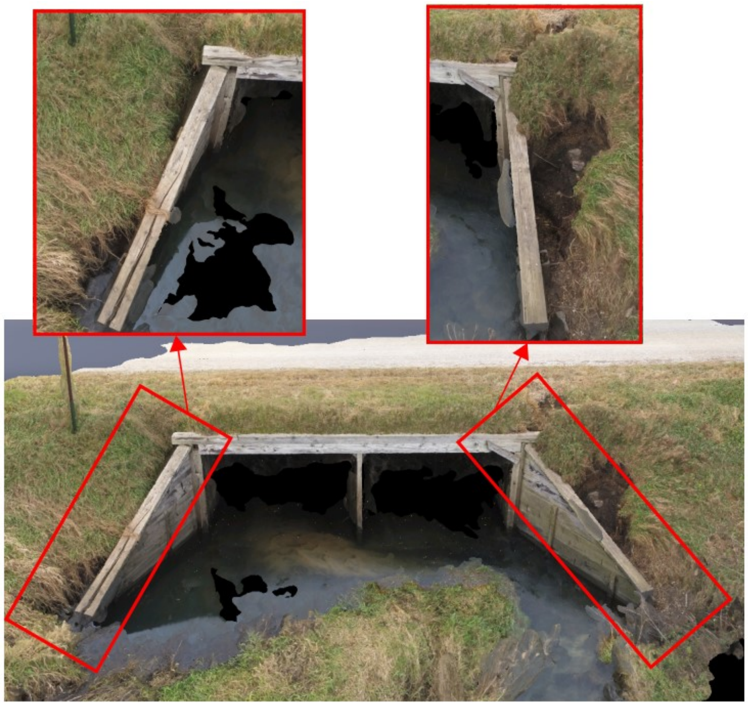


Figure 4-19 3D Model Snapshot View with Closeups of Areas of Concern

A 3D model was made of the metal pipe arch to document and measure the amount of deformation and bulging at the center of the culvert length. This Is typically a difficult task top perform since the ends of a culvert are at different elevations and the deformation has not baseline to be relative to. Using this 3D model an extremely accurate measurement of the change in curvature and any flattening could be assessed and used in the load rating of the structure.

4.5 TETTEGOUCHE BRIDGE

This case study consists of the results of an UAS bridge modeling and inspection of the Tettegouche State Park Bridge. This bridge is 383 feet long and includes a 140-foot steel deck truss main span over the Baptism River and 4 steel girder approach spans. The UAS inspection was performed in conjunction with a fracture critical inspection performed by MnDOT.

Figure 4-20 Tettegouche Bridge

4.5.1 UAS Operation

A two-person crew, consisting of a professional engineer-pilot and a field engineer, conducted the UAS inspection. The pilot was certified as a FAA Remote Pilot. The inspection was conducted using a registered UAS and AeroPoint ground control targets. The UAS was an Intel Falcon 8+ equipped with a Sony Alpha 7R camera and the majority of flight missions were preplanned using Intel Mission Control software.

During the inspection, the pilot flew the UAS and had direct line of sight. The photos were taken in four sections: Fascia, Deck, and Underside to achieve a high-resolution 3D model of the bridge. Deck and fascia sections had a preplanned mission to allow for an accurate overlap of each photo of approximately 85 percent. Underside photos were taken using manual flight control. 1,229 photos were taken in a systematic overlapping manner to ensure total photo coverage of the bridge.

4.5.2 Mission Scope

A UAS was utilized to collect inspection information and to create a 3D reality model of the bridge to aid in organizing inspection results. The bridge was processed in both Pix4D and Context Capture to compare the quality of the models. The bridge was also uploaded to Pix4D cloud platform and bridge elements and defects were recorded directly on the model.

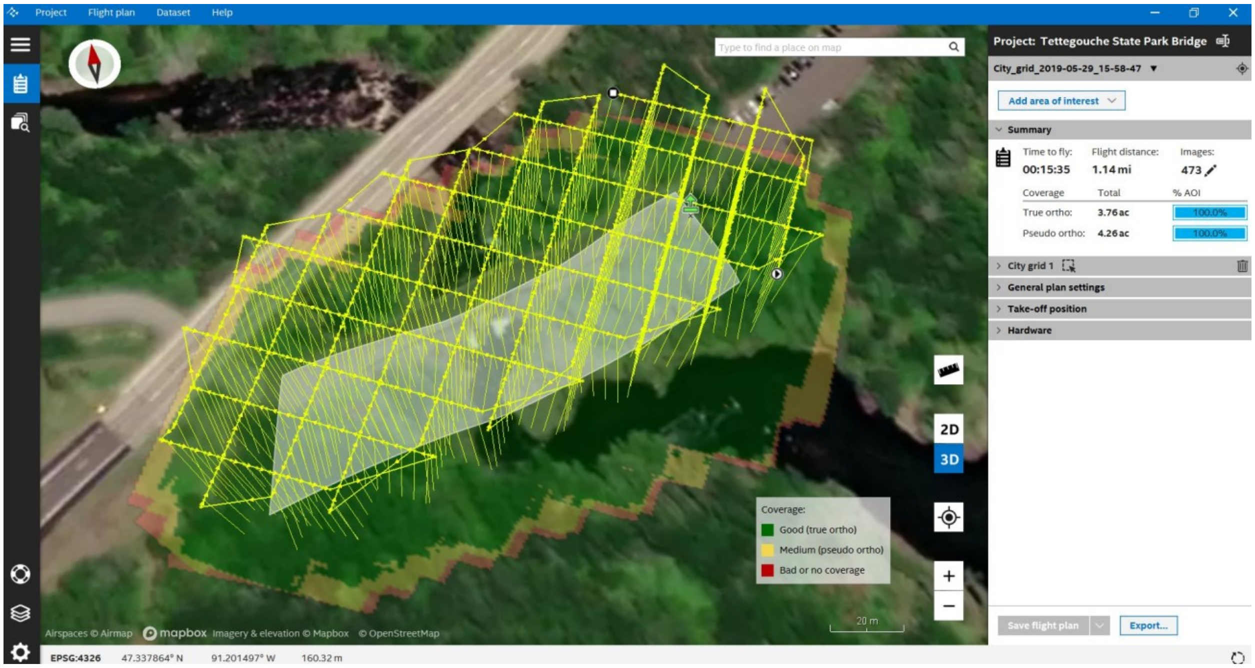


Figure 4-21 Tettegouche Bridge Flight Plan

4.5.3 Deliverables

A 3D Model with a High-Resolution Photograph Log was processed from the flights. All photographs taken during the Mapping Missions were processed in Pix4D software. The software processed the photographs to form a 3D point cloud for digital viewing. The point cloud was then processed by the same software to generate a 3D mesh of the bridge. The bridge was also processed in Context Capture and the resulting model was cleaner with less noise and modeling artifacts.

An inspector was able to use the Pix4D program to navigate the 3D model and select areas of interest. The software provides the inspector with still images containing the selected area of interest which can then be viewed in high resolution. Additionally, the inspector can place annotations or measurements in the model for repair plans and further detailed inspection.

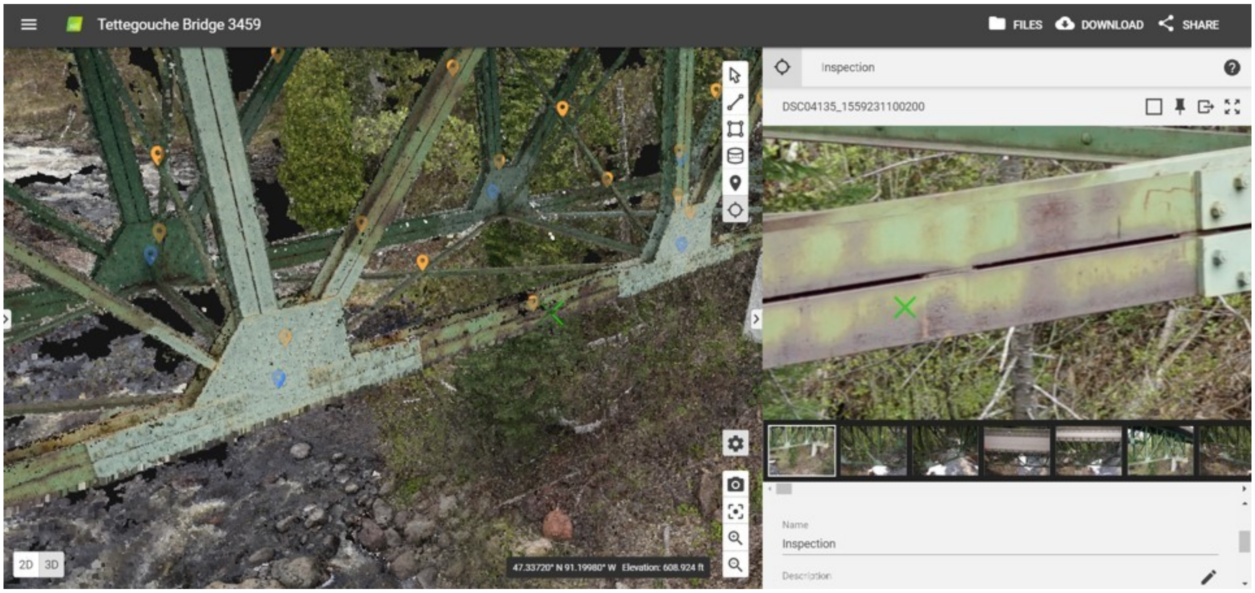


Figure 4-22 Tettegouche Bridge Pix4D Cloud Model Virtual Inspector Tool

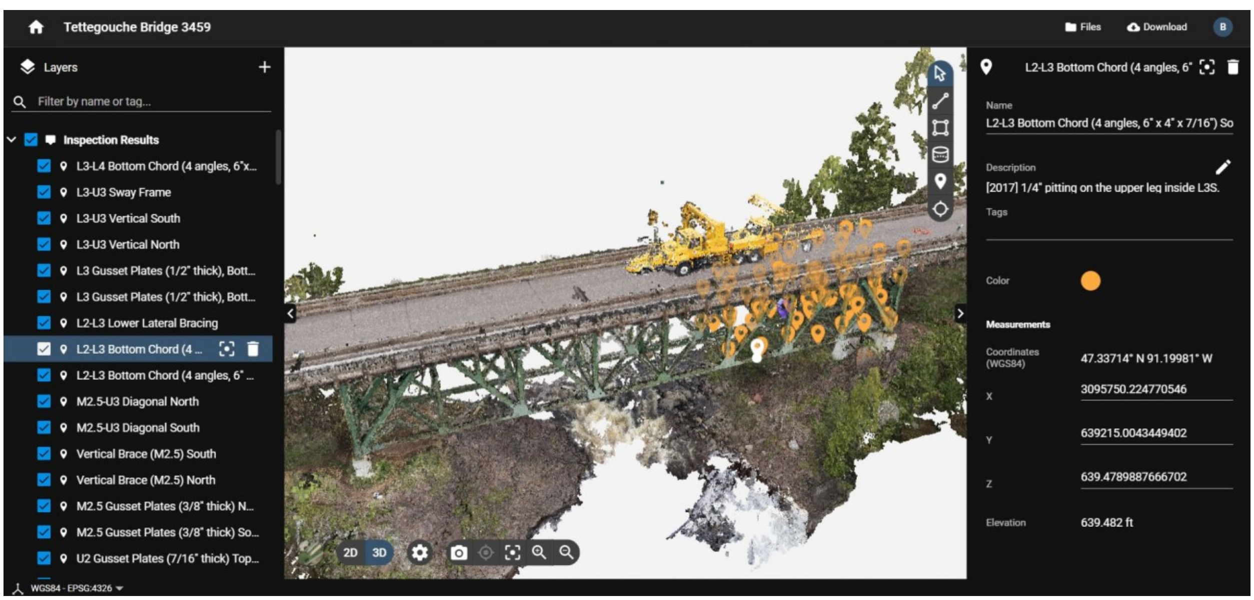


Figure 4-23 Tettegouche Bridge Pix4D Cloud Model with Inspection Notes

Figure 4-24 Tettegouche Bridge Modeled in Context Capture

Figure 4-25 Tettegouche Bridge Context Capture Model Close Up View

4.6 STONE ARCH BRIDGE INSPECTION AND REHABILITATION PROJECT

This implementation consisted of unmanned aircraft system (UAS) inspection and element condition assessment of the Stone Arch Bridge in conjunction with a rehabilitation project currently underway by Collins Engineers and LHB for MnDOT. The primary purpose was to utilize UASs to provide an 3D inspection model with georeferenced images to document bridge conditions and for use as data and a deliverable for the rehabilitation project.

The Stone Arch Bridge is located in downtown Minneapolis and crosses the Mississippi River. The bridge is a 2100-foot-long, 22 span masonry stone arch bridge built by James J. Hill for his Great Northern Railroad in 1883. The bridge served rail traffic until the early 1990's when it was converted to a pedestrian bridge. The Stone Arch Bridge is a historically significant bridge and is a landmark for the City of Minneapolis and the State of Minnesota.

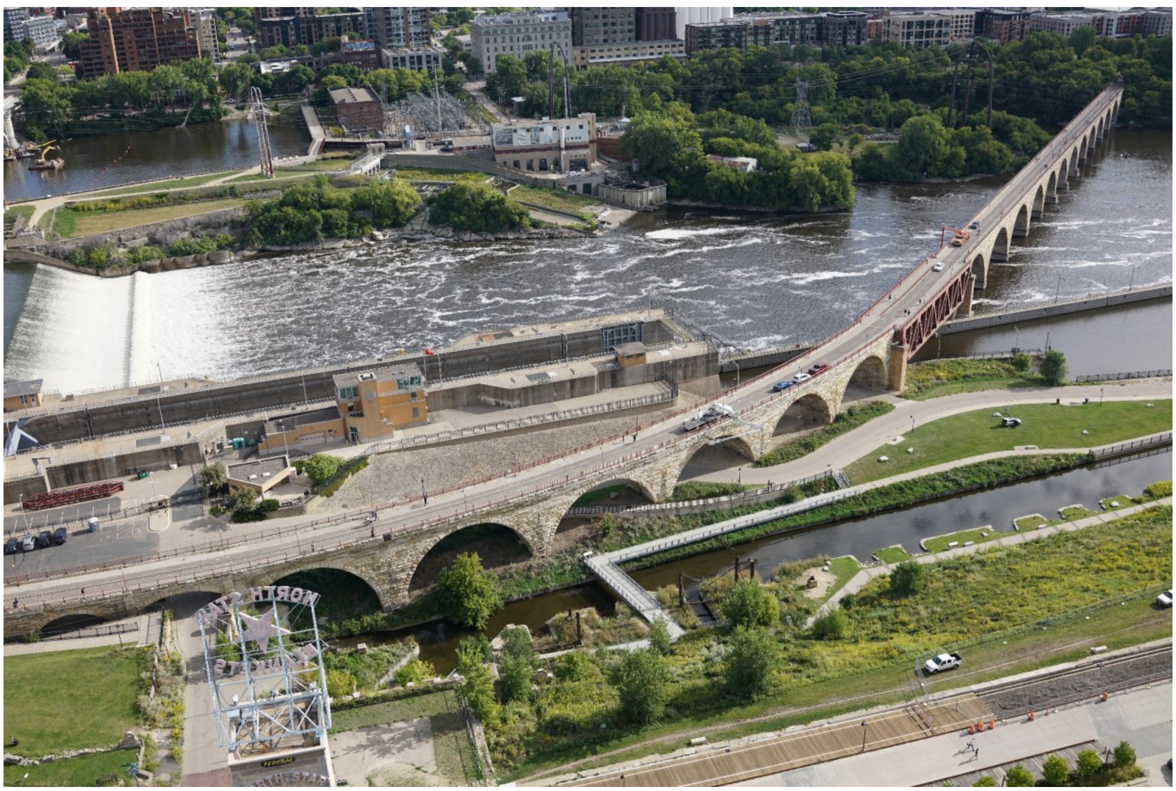


Figure 4-26 Overall Photo of the Stone Arch Bridge

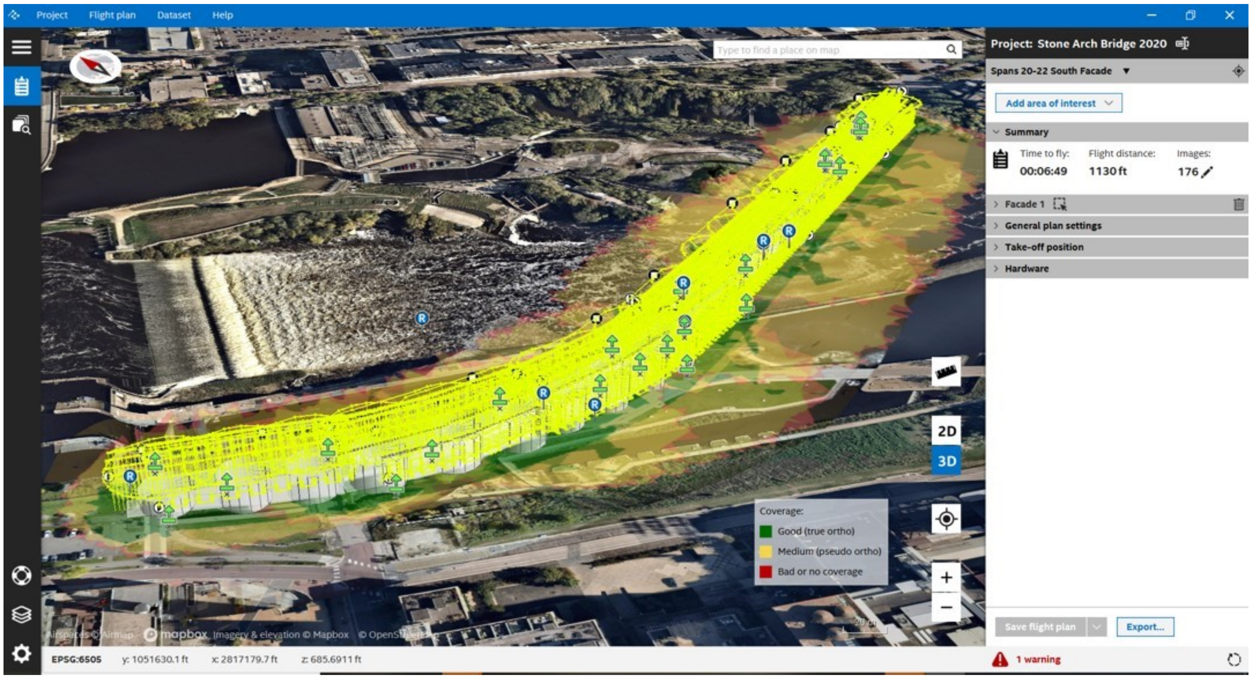


Figure 4-27 Preplanned Flights of the Stone Arch Bridge

4.6.1 Mission Scope

Collins Engineers performed the inspection of the Stone Arch Bridge as part of a rehabilitation project for the Minnesota Department of Transportation. The project included a detailed inspection of the bridge in anticipation of masonry repairs. Detailed information on the condition of the masonry was required to develop repair plans and to calculate repair quantities. As part of this project, the team utilized UAS to collect bridge data. The UAS did not replace the arm's length inspection but supplemented the inspection and provided an improved way to communicate the inspection results.

The UAS data collection process was split into two separate efforts. The first effort collected data for the entire bridge and the second effort recollected the same data for the river spans to take advantage of a river drawdown that exposed areas of the bridge that are normally underwater.

The UAS inspection was conducted using the Intel Falcon 8+ equipped with a Sony RX1R camera. The missions were preplanned using Intel's Mission Control software. During the inspection, the pilot operated the drone with the mobile cockpit controller and the other crew members maintained line-of-sight with the UAS. In order to achieve a high-resolution 3D model of the bridge, most flights were conducted autonomously using pre-planned flights to allow for a more accurate overlap of each photo of approximately 85 percent. Flights were performed from areas near the bottom of the bridge with some flight performed from the bridge deck. When flights were flown from the bridge deck additional team members were present to direct pedestrians for safety. AeroPoint automatic ground control targets were placed on the bridge deck and on the ground near the bottom of the bridge to geolocate the deliverables. The images of the underside of the arches was collected by using a boat to drive patterns under the bridge while images were triggered manually. The entire data collection effort took less than 4 days with a crew comprised of two to three bridge engineers. A video of the drone in flight collecting data can be viewed here:

Figure 4-28 Video of Falcon 8+ Performing Inspection

Figure 4-29 Aerial View of the Intel Drone Collecting Data

Figure 4-30 Intel Drone Collecting Data

4.6.2 UAS Implementation Workflow

This unique project required a workflow to incorporate the benefits of reality modeling and hands on inspection. The project workflow as it relates to UAS implementation is as follows:

1. UAS Field Data Capture
2. Digital Twin Creation
3. Field Inspection Utilizing Reality Models
4. Rehabilitation Design and Plans
5. Construction

Before any inspection was performed, the bridge was flown in its entirety and reality models were created of sections of the bridge in anticipation of a hands-on field inspection. The models were created with Context Capture and were uploaded to Projectwise for cloud sharing and editing in the field. Bridge engineers used iPad tablet computers with an internet connection to view the models and input inspection notes directly on the model during the hands on inspection. This method, the reality model and digital access while in the field was found to be advantageous.   It allowed for greater accuracy than traditional paper and pencil note taking, and efficiencies were gained from not having to locate each stone or determining which stone on the drawing the inspector was looking at as this information was easily and accurately accessible. With all notes going directly onto the model and there was no confusion about what the correct stone is. Ideally, inspection information could be prepopulated in the office and verified in the field but, the project schedule did not allow that in this case.

Figure 4-31 Reality Model of Spans 17-22

Figure 4-32 Reality Model of Spans 17-22 With Inspection Notes

Another advantage of creating and tying inspection notes to the reality model is that all of the data is available as a .json file and each note is geospatially located. The notes can be easily transferred to the construction drawings without having to manually copy notes into CAD, which is tedious and a timely process.

4.6.3 Deliverables

4.6.3.1 3D Reality Models and 2D Orthomosaics

3D Reality Models and 2D orthomosaics were generated in ContextCapture software as discussed previously. The models were generated locally on high-end desktop computers and uploaded to Projectwise. The models provided a way to communicate visually the current condition with a virtual interactive environment and provide means for future comparisons. The reality models are being used locally in Microstation to develop repair plans and are also available on Projectwise for all team member to view.

The following figure is a model of spans 1-12 that was created from the data collected during the river drawdown. This model represents a unique opportunity to capture data and display what the bridge looks like for the portions of the bridge that is normally underwater. The river basin is drawn down approximately every 12 years so, this data will be valuable for many years to come.

Figure 4-33 3D Reality Model of Stone Arch Bridge During River Drawdown

Figure 4-34 Reality Model Zoomed in to Pier During River Drawdown

Figure 4-35 2D Orthomosaic Overall

Figure 4-36 2D Orthomosaic Medium Close Up

Figure 4-37 2D Orthomosaic Close Up

4.6.3.2 Artificial Intelligence

The models of the Stone Arch Bridge were analyzed using artificial intelligence and machine learning to find cracks on the masonry. ContextCapture Insights software was used to find and delineate the cracks automatically. While the algorithms are not perfect, they were impressive and this technology gives engineers a quick way to find and quantify cracking which is difficult to complete in the field using hand tools. Cracks are typically very irregular in their nature which makes it challenging to measure and document accurately.

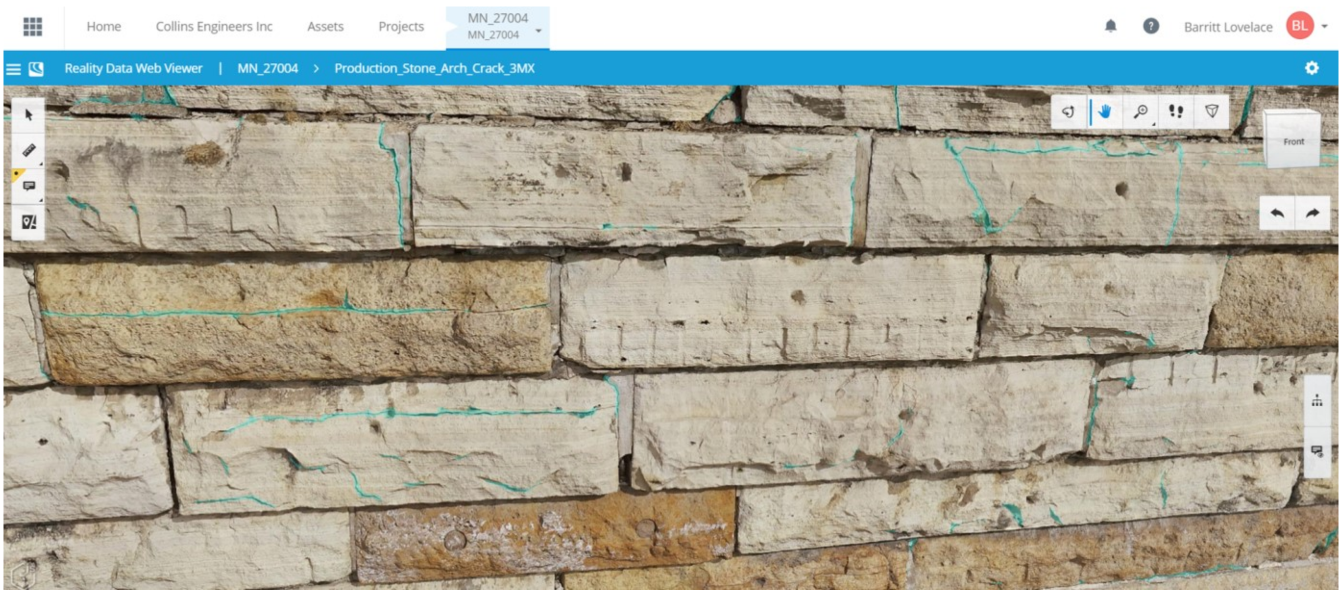


Figure 4-38 ContextCapture Insights AI Crack Detection

4.6.3.3 Holographic Virtual Inspections

Another deliverable that we created with Bentley Inc. is the ability to view and annotate the bridge model using the Microsoft Hololens 2. This unique method allows team members to perform virtual inspections of the bridge from their office.

Figure 4-39 Virtual Inspection of Bridge Using Microsoft Hololens 2

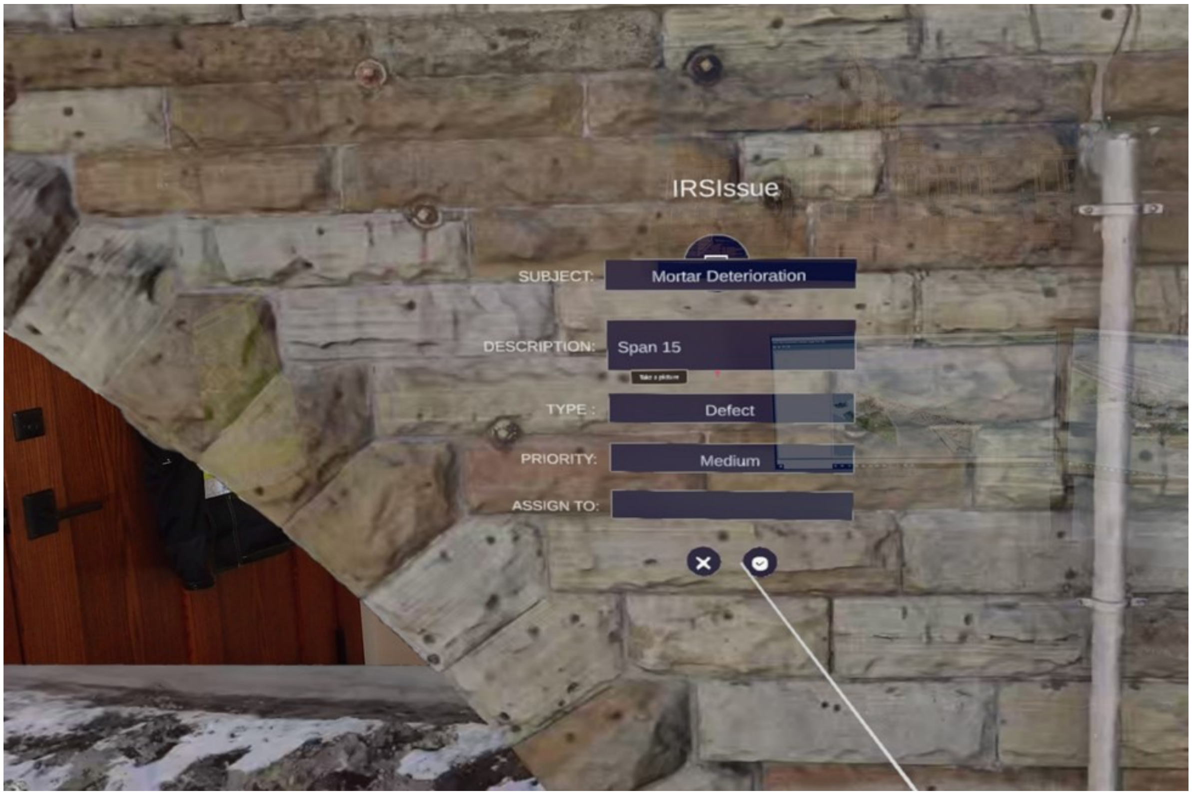


Figure 4-40 Hololens Inspection Defect Notation

More information on the holographic virtual inspection process can be found here:

Figure 4-41 Hologram Virtual Inspection Process

4.6.4 Findings

4.6.4.1 Advantages

The execution of the modeling with the Intel Falcon 8+ in combination with ContextCapture Software was successful and provided a very useful way to document and communicate the conditions of the bridge. The set-up, flight, and data generation went as planned and was substantial enough to create the planned deliverables. The deliverables demonstrated that significant improvements were made to the inspection documentation workflow. Defect measurement was accurate, simple to gather, and easier to share with the project team members.

The preplanned missions from the Intel Software can be used in the future to collect the same data from the same locations and will offer a direct comparison of any deterioration between inspection cycles.

4.6.4.2 Limitations

Minor limitations were presented when acquiring the data in the field. One limitation was that a large bridge can be difficult to model. The bridge is a very popular and busy pedestrian bridge so, our field teams had to be very careful when flying the drone and worked earlier in the day when there were fewer pedestrians. Another minor limitation was working with the large volume of data can be computer and network intensive but utilizing high-end processing computers allowed for reasonable workflows.

4.6.5 Conclusion

4.6.5.1 Advantages

The execution of the 3D modeling mission was successful and provided some insight into the potential for UAS as a tool during load ratings for measurements and deficiency mapping. The set-up, flight, and data generation went as planned and was substantial enough to create the planned deliverables. The deliverable demonstrated improvements which can be made to the inspection documentation. Defects could be measured, simple to gather, and easier to share with the bridge owner. This could be a powerful tool to be more transparent from the field to the office in any areas the inspector feels may influence the performance of structures.

Photogrammetry methods using terrestrial devices proved to be beneficial for field work as it provided the owner a more comprehensive outlook of the structures. This method also helped for post-inspection evaluation giving the inspector an effective way to accurately translate defects and measurements for future monitoring.

4.6.5.2 Limitations

The value of the models related to load ratings included in this report seemed to be limited to the documentation of defects and global measurements. Taking the photos and processing them did add extra time to perform and small critical measurements such as steel thickness, member dimensions, and wearing surface thickness still should be measured by hand in the field.

CHAPTER 5: SAFETY AND OPERATION MANUAL

5.1 OVERVIEW

An Unmanned Aircraft Systems (UAS) Safety and Operation Manual was developed as part of this project. The manual can be found in Appendix A. The intent of the manual is to provide a risk-based approach to deciding when to take advantage UAS for bridge inspections. Also included are best practices for when UAS is used to help minimize the risk of incidents which could cause damage to the drone, property, or injuries. The manual is based on five years of drone use within MnDOT and while risks cannot be eliminated, the application of the best practices will minimize these risks significantly.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 PROGRAM APPLICATION

Unmanned Aircraft Systems have proven to be a low cost and low risk way to supplement bridge inspection efforts in Minnesota. Technology from both hardware and software continue to evolve making it more accessible to bridge inspectors and making the deliverables more beneficial and accessible.

6.2 INITIAL IMPLEMENTATION

As part of this project, UAS was applied to many bridge inspections using different applications. The bridges ranged from small simple structures to major signature river crossing bridges. The data collected was integrated into the inspection reports mostly by including links in the report to cloud-based, web sharing platforms.

6.3 SUSTAINED IMPLEMENTATION

MnDOT is has recently purshased a fleet of drones in addition to the Flyability Elios that is already owned by MnDOT Metro District. The purchase and use of these new drones will exponentially increase the implementation of UAS for bridge inspections within MnDOT. This report and the Safety and Operation Manual Bridge UAS Operations Manual should provide a framework for a successful implementation. This implementation will benefit MnDOT by lowering inspection costs, increasing safety for bridge inspectors and the traveling public and provide an additional access tool in tandem with the use of snoopers and rope access. Perhaps even more significant, the utilization of UASs and reality models provides not only an increased amount of data but also, an improved accuracy of the data. These enhancements will allow engineers to make data driven decisions to better manage these assets throughout their lifecycle.

REFERENCES

Federal Highway Administration, (2004) *National Bridge Inspection Standards*, 23 CFR 650, FHWA, Washington, DC.

U.S. Department of Transportation (2012), *Bridge Inspector's Reference Manual*, Federal Highway Administration, Washington, DC.

Minnesota Department of Transportation (2020), *Bridge and Structure Inspection Program Manual*, MnDOT Office of Bridges and Structures, Oakdale, MN

Federal Aviation Administration (2020). Internet. Unmanned Aircraft Systems, Retrieved from https://www.faa.gov/uas/.

APPENDIX A

UNMANNED AIRCRAFT SYSTEMS (UAS) SAFETY AND OPERATION MANUAL

STATE OF MINNESOTA

Bridge and Structure Inspection Program Manual

DEPARTMENT OF TRANSPORTATION

Chapter U

UAS SAFETY AND OPERATIONS MANUAL

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U.1 OVERVIEW

An Unmanned Aircraft System (UAS) is defined by the Federal Aviation Administration (FAA) as an aircraft operated without the possibility of direct human intervention from within the aircraft. Unmanned aircraft are commonly referred to as drones, and the names can be used interchangeably. The use of UASs to aid in bridge inspection should be considered as a tool for a qualified Team Leader when a hands-on inspection is not necessary or required. UASs are controlled either autonomously or with the use of a remote control by a pilot from the ground. Current technologies for commercial use include both fixed wing and rotor aircraft, although for bridge safety inspections rotary aircraft are more suitable. A wide range of imaging technologies including still, video, and infrared sensors can be utilized. On-site or in-office image processing can be used to produce inspection deliverables. UASs themselves cannot perform inspections independently but can be used as a tool for bridge inspectors to view and assess bridge element conditions in accordance with the National Bridge Inspection Standards.

This chapter is not intended to be a complete training manual on the use of UAS for bridge inspection but is intended to establish best practices and guidelines for a risk based approach to improve inspection outcomes. The owner or engineer may have to implement additional requirements that exceed those outlined in this chapter based on specific site conditions and engineering judgment or when presented with unusual circumstances.

U.1.1 UAS USE PHILOSOPHY

Drones have proven to be a useful tool to provide alternative methods of access and to improve the quality of data for a bridge inspection. Bridge inspectors should consider incorporating the use of drones into a bridge inspection with the following guidance:

U.1.1.1 Safety Improvements

Drones should be considered when safety improvements can be realized for inspectors and/or the traveling public. Risks can be reduced by eliminating or reducing the need for:

- Personnel Working Near Traffic
- Traffic Control
- Personnel Working from Heights

Drones themselves can introduce their own risks which should be weighed against safety improvements. As an example the risk and consequence of a collision with a pedestrian should be weighed against the risk and consequence of a traffic accident resulting from a lane closure.

U.1.1.2 Reduced Costs

Drone use for bridge inspection has shown cost savings when traffic control and snooper use can be reduced. These cost savings should be considered especially when the quality of the inspection remains the same or improves.

U.1.1.3 Improve Data/Deliverables

Drones can improve the quality and quantity of data collected during an inspection and their use should be considered when these improvements can be realized.

U.2 ABBREVIATIONS

AMSL – Above Mean Sea Level

AGL – Above Ground Level

ATO – Above Take Off

ATC – Air Traffic Control

BVLOS – Beyond Visual Line of Sight

COA – Certificate of Waiver or Authorization

CFR – Code of Federal Regulations

PIC – Pilot in Command

UAS – Unmanned Aircraft System

sUAS – Small Unmanned Aircraft System

FPV – First Person View

GPS – Global Positioning System

NAS – National Airspace System

NOTAM – Notice to Airmen

TFR – Temporary Flight Restrictions

FAA – Federal Aviation Administration

VO – Visual Observer

LAANC – Low Altitude Authorization and Notification Capability

U.3 UAS OPERATIONS

The following sections describe the recommended operating procedures and considerations when using UAS for bridge inspections.

U.3.1 RULES AND REGULATIONS

U.3.1.1 Federal Aviation Administration

The Federal Aviation Administration (FAA) of the United States is a national authority with powers to regulate all aspects of civil aviation. These include the use of UAS for commercial purposes. All bridge inspections that utilize UAS are required to follow the FAA's UAS requirements.

UAS operations are allowed with a Certificate of Waiver or Authorization (COA) or under the FAA's Part 107. Part 107 applies to drones weighing less than 55 pounds, operated within the visual line of sight of the remote pilot in command, and flown during daylight hours. The remote pilot in command must have a Remote Pilot Certification from the FAA which can be obtained by passing an aeronautical knowledge test. With direct supervision from a licensed remote pilot, anyone over the age of 16 can legally operate a drone for commercial purposes. Each UAS must be registered with the FAA. Operations in Class G airspace are allowed without air traffic control permission (ATC), however operations in Class B, C, D and E airspace need air traffic control approval. A basic summary of the requirements is included below.

Pilot Requirements	Must have Remote Pilot Airman Certificate Must be 16 years old Must pass TSA vetting
Aircraft Requirements	Must be less than 55 lbs. Must be registered if over 0.55 lbs. (online) Must undergo pre-flight check to ensure UAS is in condition for safe operation
Location Requirements	Class G airspace can be flown under part 107 without an FAA waiver. Classes B, C, D, and E airspace can be flown with an FAA waiver
Operating Rules	Must keep the aircraft in sight (visual line-of-sight) Must fly under 400 feet Must fly during the day Must fly at or below 100 mph Must yield right of way to manned aircraft Must NOT fly over people Must NOT fly from a moving vehicle
Legal or Regulatory Basis	Title 14 of the Code of Federal Regulation (14 CFR) Part 107

More information on Part 107 can be found on the FAA website.
https://www.faa.gov/uas/getting_started/fly_for_work_business/

U.3.1.2 MnDOT Requirements

The offices of Aeronautics and Chief Counsel provide assistance to districts and offices that are pursuing or contracting for UAS services. The Aeronautics Office has an official policy for the use of UAS on MnDOT projects. The policy and procedures is detailed at the following website: http://www.dot.state.mn.us/policy/operations/op006.html

For UAS operation, MnDOT employees must:

- Obtain a blanket public Certificate of Waiver or Authorization (COA) that permits flights in Class G airspace at or below 400 feet, or
- Perform operations that adhere to 14 CFR Part 107 ("Part 107" operations).
- Create a safety and operations plan that addresses all aspects of the intended mission.

When contracting for UAS services, the contractor must adhere to the requirements of Part 107. MnDOT will review Section 333 Exemption and COA of third parties, and these contractors will be required to license the vehicle and obtain a commercial operator's license from the MnDOT Office of Aeronautics as required by Minnesota Statutes §360.521 - Minnesota Statutes §360.675.

U.3.1.3 Qualifications

FAA and MnDOT rules and regulations should be considered a minimum. The pilot in command should be experienced and confident in each application and in each environment in which it is used. The pilot and team members should be well versed in the particular drone models operating procedures and limitations. Each mission should be evaluated for risks and carefully planned to mitigate for those risks.

U.3.3 EQUIPMENT

UAS equipment is available that is specific to inspections with features that are important when performing bridge inspections. It is recommended to employ a UAS specifically designed for the particular mission. Consideration should be given to the robustness and reliability of the drone to ensure safety and quality results. While technologies and capabilities differ, the most common inspection UASs share these general features:

- Powered by rechargeable batteries
- Controlled either autonomously or with a remote-control device
- Contain 4 to 8 rotors
- Ability to use GPS to track location
- Contain fail safes such as return to home technology
- Includes a camera with both video and/or still image capabilities
- Thermal sensors
- Proximity sensors and awareness
- Ability to preprogram autonomous missions

- Ability to fly under bridge decks in a GPS denied environment and within confined spaces.
- Ability to look up to view the underside of a bridge deck

U.3.3.1 Battery Safety

Lithium Ion Batteries require special care to ensure they perform reliably. The following guidelines will help ensure batteries perform as designed. Specific care tips can also be found in each drones manual.

- Never fully discharge a battery.
- Do not store batteries fully charged.
- Only charge batteries in areas free from flammable materials.
- Never charge batteries unattended.
- Never store batteries in extreme temperatures.
- Protect batteries from punctures or impact damage.

U.3.3.2 Drone Airframe and Propellers

Any UAS used should have a preflight inspection performed to ensure the equipment is operating properly. Special attention should be paid to critical parts including propellers and should be replaced according to manufacturer recommendations. Any discrepancies during flight should be logged and addressed.

Drones should be inspected for damage prior to mobilizing for and inspection and prior to each individual flight. A visual and tactile inspection of the drone propellers should be performed to identify damage. Propellers with any sign of damage or cracking should be replaced prior to use. Logs should be kept detailing when maintenance and repair activities have occurred.

Figure 1- 1 View of Flyability Elios under a bridge

U.3.5 PRIVACY

Most bridge inspections are performed in areas where the public does not have a reasonable expectation of privacy. However, the privacy of the public should be respected and flying over private property should be avoided when possible.

U.3.6 ROLES AND RESPONSIBLITIES

U.3.6.1 Inspection Team

The UAS operator is required by the FAA to have a Remote Pilot Certification. In addition, the operator should be very familiar with the UAS and have studied the owner's manual and received training on the operation of the UAS before attempting to fly near a bridge. Similar to manned aircraft, the crew should not operate with a medical condition that could interfere with safety. Generally, the minimum size of a crew should be two people, one to operate the aircraft and one to act as a spotter. It is recommended that the operator also be a qualified bridge inspector and at a minimum, the bridge inspector should always be on site directing the inspection.

Bridge inspections that utilize UAS should not deviate from FHWA and MnDOT requirements for Bridge Inspection Qualifications. The team leader should remain in control of the inspection efforts and if possible, the PIC should be a qualified inspector.

- Pilot in Command (PIC) – This person holds a remote pilot certification and has the final authority for flight operations. The PIC is responsible for planning and safe operation of the UAS during the inspection. Ideally this person is also a qualified bridge inspector. The PIC should only communicate with the VO during flights and distractions should be minimized.
- Visual Observer (VO) – This person assists the PIC to help identify air traffic, obstacles, vehicles and pedestrians. The VO should be in direct communication of the PIC throughout each flight.
- Support – Additional field staff may be required to monitor pedestrians and the public or to provide additional VO support in congested areas.

U.3.7 INSPECTION PLANNING

Flights should carefully planned before mobilization in the field. Equipment necessary for the inspection should be listed and compiled. Autonomous flight plans should be prepared and any site-specific obstacles or challenges should be identified and addressed. Weather should be monitored and airspace restrictions should be checked. If airspace waivers are required they should be obtained from the FAA prior to mobilization. Temporary Flight Restrictions and Notices to Airmen should also be checked just prior to mobilizing for the inspection. Once mobilized in the field flight planning should be reviewed and adjusted based on site specific conditions.

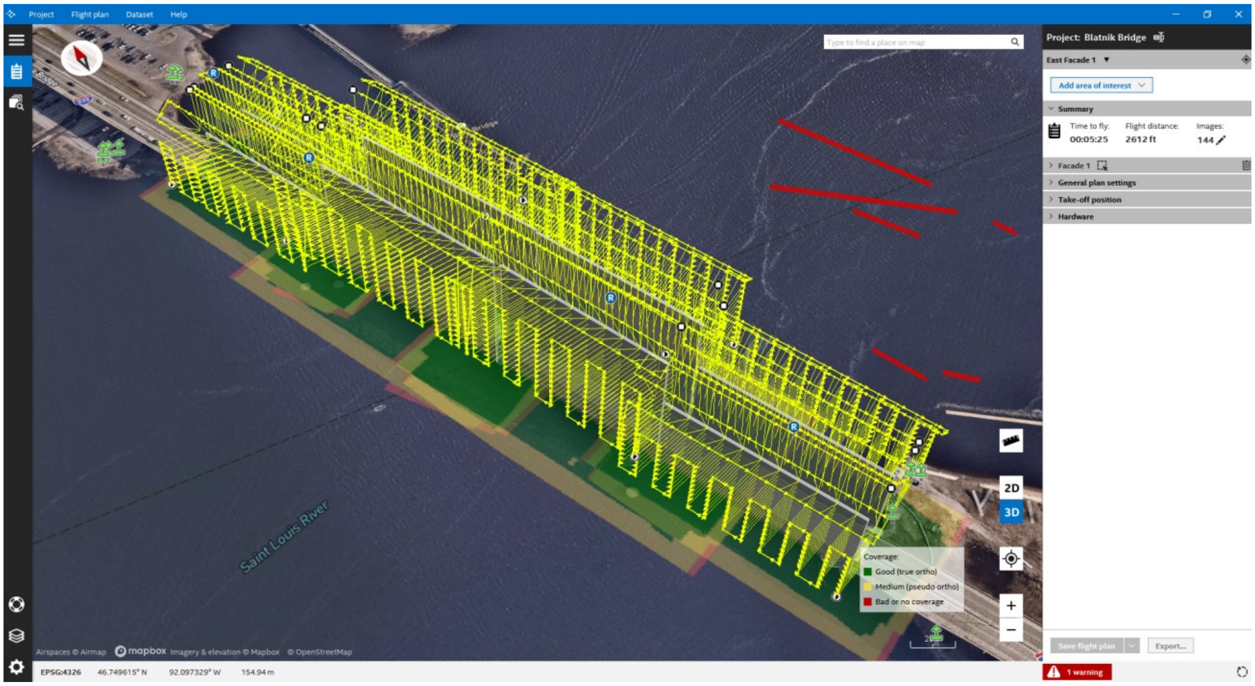

Figure 1- 2 Screenshot of flight planning software demonstrating a flight plan for a bridge.

Automated Bridge Flight Plan Example

A safety plan should be prepared that addresses site safety and the proper qualifications of personnel and proper use of the UAS. The safety plan should address the following:

- Purpose of the effort
- Field team personnel
- Site location
- Structure description
- Any site-specific hazards
- FAA airspace class and waiver status if required
- Any privacy concerns

All personnel should be equipped with full personal protective equipment including eye protection and hard hats. The operations area should be delineated with cones, signs, and markers. If operations include the possibility of drivers seeing the drone within close proximity.

U.3.8 FIELD OPERATIONS

The PIC has the ultimate authority over the flight operations and the responsibility to determine if flights can be safely perform considering weather and site conditions. Checklists should be utilized to ensure safe flights. While each specific UAS will have its own specific checklist the following list includes general checklist items that should be included.

Flight Checklist

- ☐ Remote Pilot Certificate
- ☐ UAS registered
- ☐ Updated firmware/apps
- ☐ Airframe Inspected
- ☐ Batteries charged
- ☐ Weather conditions checked
- ☐ NOTAMs/TFRs
- ☐ Identify Site Hazards and Obstacles
- ☐ Preflight Risk Assessment
- ☐ Airspace authorization
- ☐ Site plan/flight plan prepared
- ☐ Part 107 Compliance
- ☐ Verify GPS and Control Links
- ☐ Verify home point set and return to home parameters verified
- ☐ Scope/Deliverables Defined
- ☐ PPE
- ☐ Landing Area Delineated
- ☐ Return to home location and procedures understood and set
- ☐ Safety Briefing Performed
- ☐ Crew Mobile Devices off or in Airplane Mode

U.3.8.1 Signs

Drone Inspection Ahead signage should be placed so drivers are not distracted by a UAS. An onsite safety briefing should be performed before work begins on the site each day

Figure 1- 3 Drone inspection ahead sign at the Stone Arch Bridge in Minneapolis.

U.3.8.3 PPE

Personal Protective Equipment should include the following as needed based on site conditions:

- Reflective Clothing or Vests
- Safety Glasses
- Cut Proof Gloves
- Hearing Protection
- Respirators or Masks
- Skin Protection

Figure 1- 4 UAS Inspection staff wearing PPE at the St. Croix Bridge.

U.3.8.6 Risks and Mitigations

UAS can be flown safely when risks are properly mitigated. Risk is managed by evaluating the likelihood of failure and the consequence of failure. An example would include hitting a manned aircraft during a bridge inspection would be a low likelihood of failure but a high consequence of failure. Alternatively hitting a tree with the drone would be a higher likelihood of failure but a low consequence of failure. We can manage risk by monitoring, managing, mitigating or reevaluating. The following chart can be used to assess risks. No operation is without any risk but as we increase the like

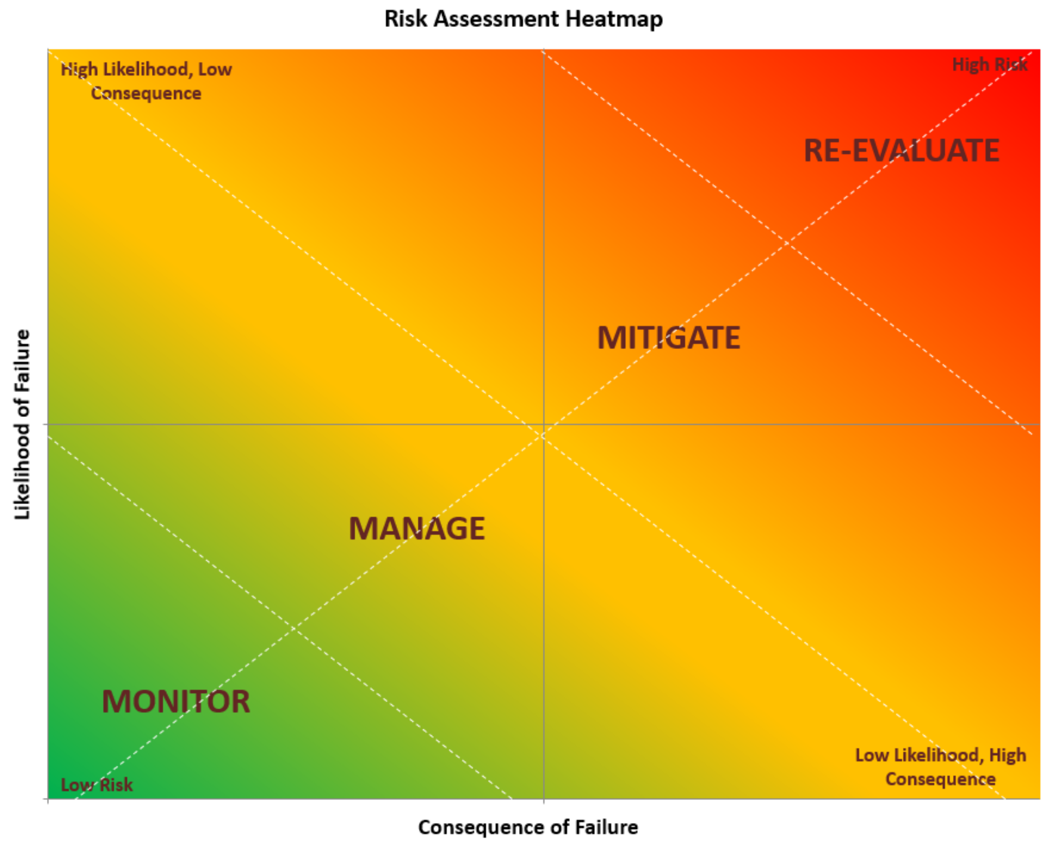

Figure 1- 5 Risk chart showing the likelihood of failure

The following is a list of risks associated with flying drones for inspection and some mitigation strategies that can be employed to limit the risks.

Risk: Collision with Manned Aircraft

Mitigations: Redundant Control Systems

Additional Visual Observer(s)

Limit size and weight of UAS

Limit ceiling of drone flights to lower altitude

Utilize Pilots with Higher Experience Level

Risk: Collision with Pedestrians or Vehicles

Mitigations: Limit Size and Weight of UAS

Increase Horizontal Distance from Public

Redundant Battery Systems

Clearly Delineate Landing Area

Shut off Motors if Crash Imminent

Preplanned Ditch Procedures and Locations

Risk: Collision with Structure Being Inspected

Mitigations: Use Collision Tolerant Drone or Propeller Guards

Utilize UAS Collision Avoidance Technology

Additional Visual Observer(s)

Increase Stand Off Distance

Risk: Propeller Injuries

Mitigations: PPE

Cut Proof Gloves

Proper Clothing

Shut off Motors if Crash Imminent

Preplanned Ditch Procedures and Locations

Limit Size and Stiffness of Propellers

Risk: Loss of Signal

Mitigations: Monitor Signal Strength

Utilize Return to Home Function

Limit Distance to Operator

Use Reliable Drones

Another important factor when evaluating risk when performing UAS missions is the risk associated with the alternative method of access. Flying a UAS to obtain inspection information may be less risky than closing a lane and using an under bridge inspection vehicle and so the mission and so any risk from UAS is less than the traditional method and therefore UAS should be utilized. Additionally, the value of the UAS mission should be considered and a more valuable missions can tolerate more risk. For instance, bridge safety inspection information collection should tolerate more risk that just taking an overall bridge photo for promotional purposes.

U.3.9 RESULTS AND DELIVERABLES

Each inspection utilizing UAS should consider the scope and goal of the inspection. A wide verity of deliverables can be created to improve the inspection documentation. UAS can be utilized for bridge and structure inspection in a wide range of applications including the following:

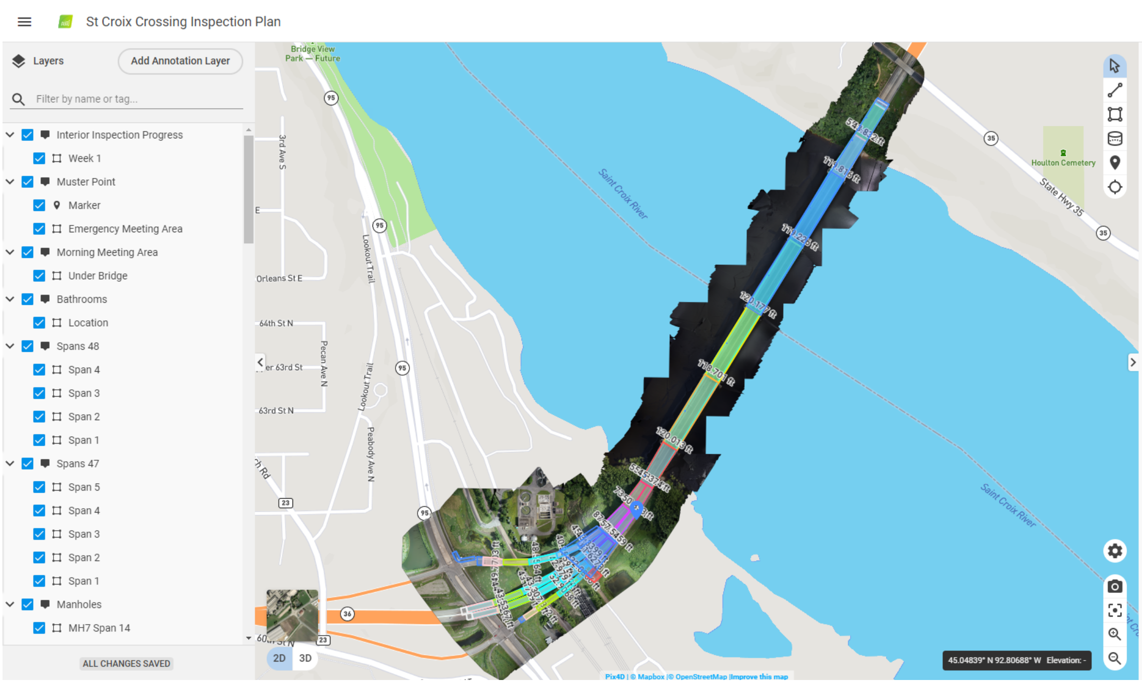

Figure 1- 6 Map showing inspection plan notes for the St. Croix Bridge Inspection.

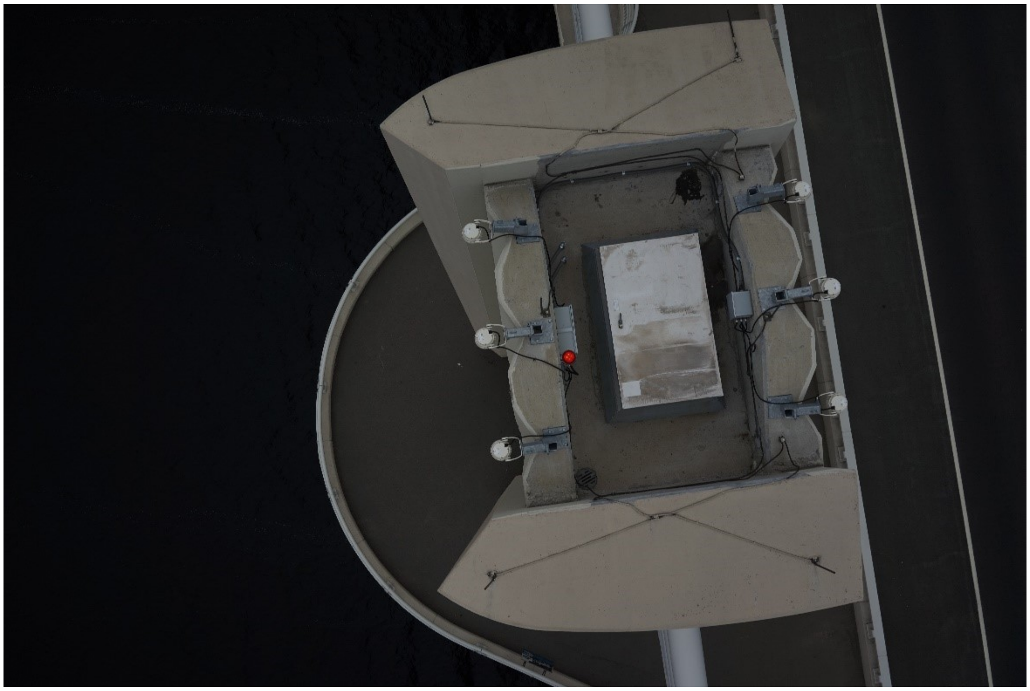

Figure 1- 7 A close-up view of a hard to reach area at the top the pier on the St. Croix Bridge

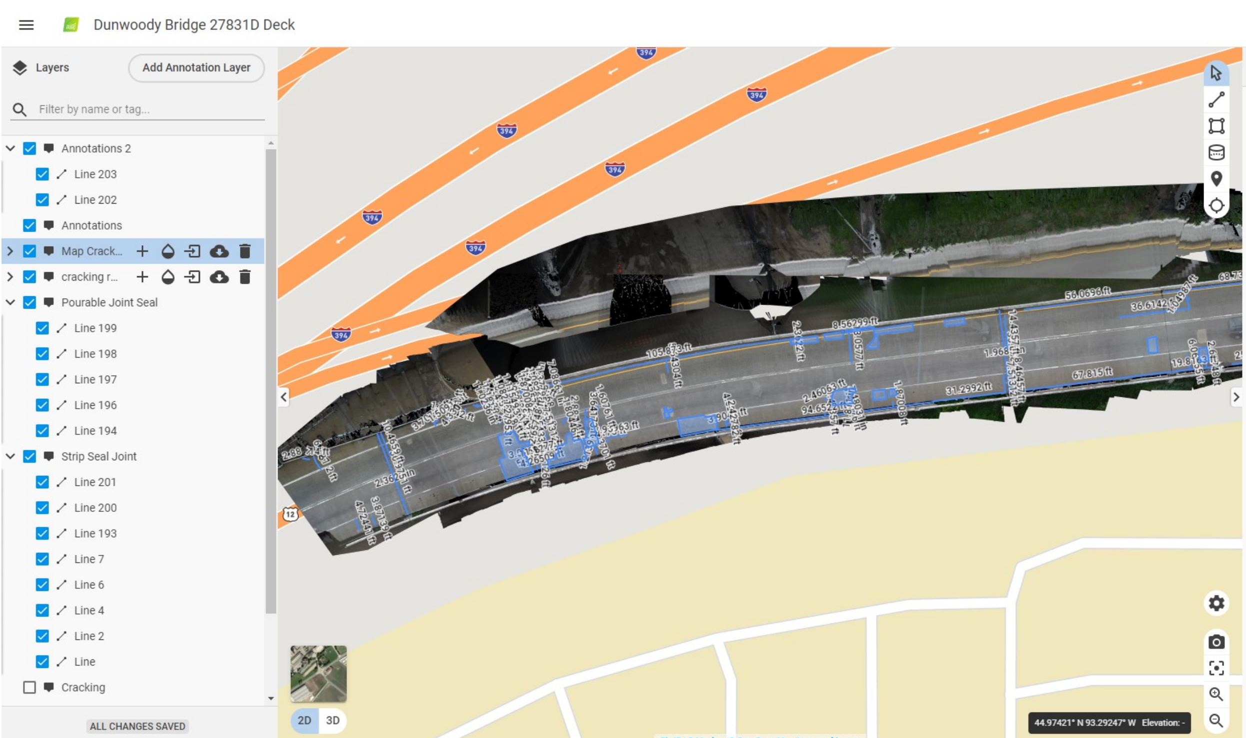

Figure 1- 8 Bridge Deck Surveys

Figure 1- 9 Routine Inspection 3D Models

Figure 1- 10 Inspection Results Annotation

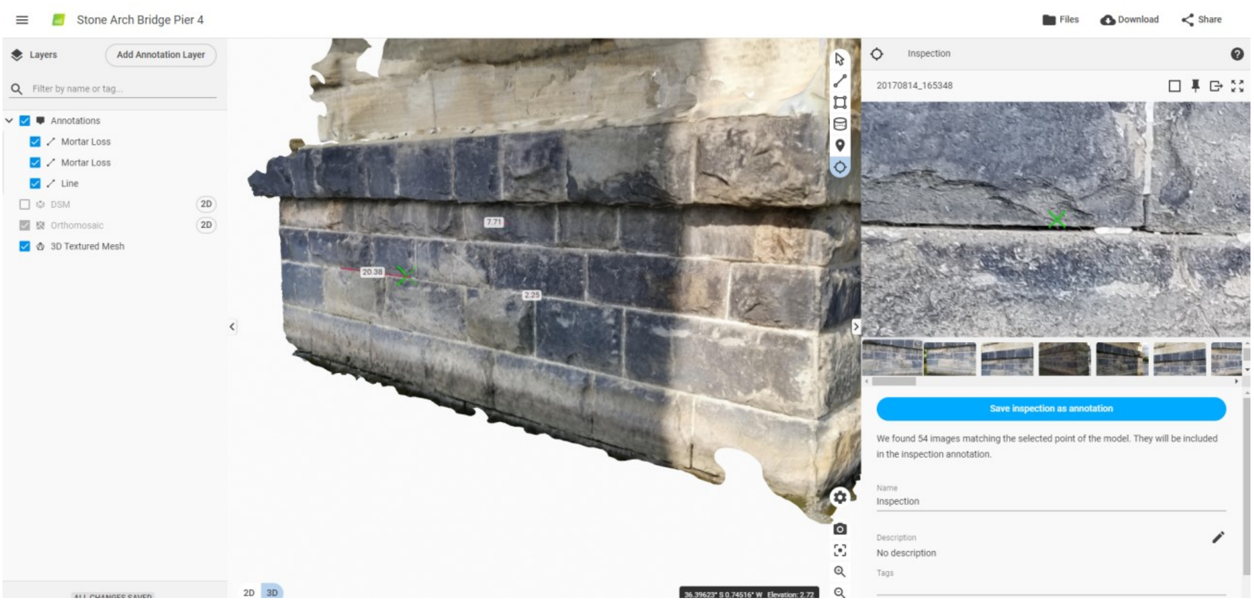

Figure 1- 11 Individual Bridge Element Modeling

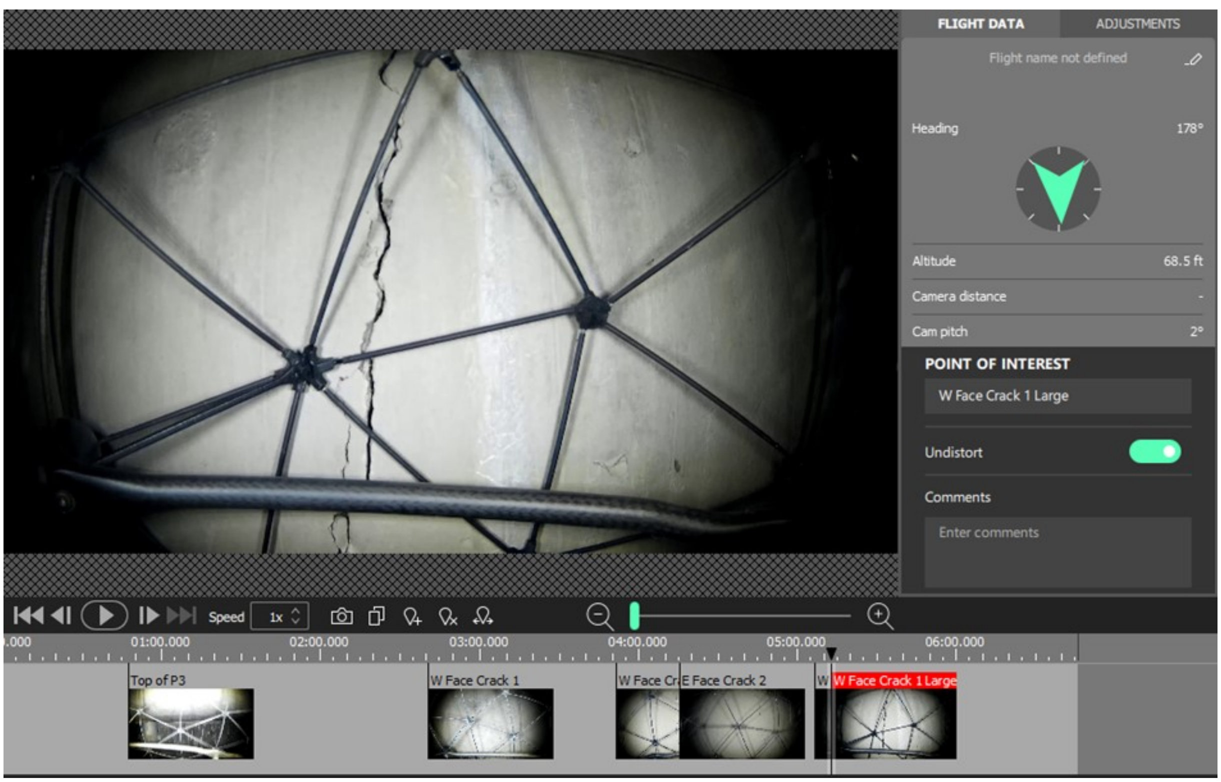

Figure 1- 12 Confined Space Inspection

APPENDIX B
MNDOT METRO DISTRICT PRIORITIZED UAS BRIDGE LIST

Asset Name	Latitude	Longitude	Airspace	Schedule	No Flights over Traffic - Total Score (0-100)	Flights over Traffic - Total Score (0-100)	Feature Intersected	ADT	Bridge Type/ Interior Inspections	Previous Success/ Knowledge	Bridge Condition (NBI)	NBI 27: Year Built	NBI 6A: Feature Intersected: Narrative	NBI 7: Facility Carried by Structure	NBI 29: Average Daily Traffic (ADT)	NBI 26: Functional Classification ofRoute	NBI 16: Latitude: Degree	NBI 16: Latitude: Minute	NBI 16: Latitude: Second	NBI 17: Longitude: Degree	NBI 17: Longitude: Minute	NBI 17: Longitude: Second	Main Span Detail Def	MN Main Span Design	NBI 58: Deck	NBI 59: Superstructure	NBI 60: Substructure
27004	44.9807444	-93.2533028	airmap	48	90	90	20	20	0	25	25	1883	Mississippi River	PED AT ST ANTHONY	1		44	58	50.68	-93	15	11.89	E	4	7	6	4
27201	44.9484222	-93.2381889	airmap	24	70	70	20	0	10	25	15	1996	LAKE ST	TH 55	40623	14	44	56	54.32	-93	14	17.48		7	6	8	7
62090	44.9332611	-93.1043333	airmap	48	80	80	20	10	10	25	15	1986	STREETS; MISS RVR; RR	TH 149	14000	16	44	55	59.74	-93	06	15.60	V	24	9	6	7
82045	45.0420194	-92.7850806	airmap	48	80	80	20	10	10	25	15	2017	ST CROIX RIVER-TH95-UPRR	TH 36	18400	14	45	02	31.27	-92	47	06.29		7	8	7	7
82047	45.0369611	-92.7917556	airmap	24	65	65	20	20	10	0	15	2016	UP RR	TH 36 WB EXIT RAMP	1	14	45	02	13.06	-92	47	30.32		7	8	8	8
82048	45.0360667	-92.7911	airmap	24	65	65	20	20	10	0	15	2016	UP RR	TH 36 EB ON RAMP	1	14	45	02	09.84	-92	47	27.96		7	8	8	8
10021	44.7678	-93.7900694	airmap	48	55	55	20	20	0	0	15	1974	TCW RR; CSAH 36	US 212 WB	4225	02	44	46	04.08	-93	47	24.25		1	7	6	7
10022	44.7675972	-93.7902389	airmap	48	55	55	20	20	0	0	15	1974	TCW RR; CSAH 36	US 212 EB	4250	02	44	46	03.35	-93	47	24.86		1	6	7	6
10044	44.8132278	-93.5414417	airmap	24	55	55	20	20	0	0	15	2003	Bluff Creek	TH 101	4850	16	44	48	47.62	-93	32	29.19		1	7	8	7
10X02	44.86275	-93.5741806	airmap	24	45	45	20	0	10	0	15	2000	Bluff Creek Trail	TH 5	34500	16	44	51	45.90	-93	34	27.05		12	N	N	N
10X04	44.8627778	-93.5589	airmap	24	45	45	20	0	10	0	15	2000	Riley Creek Trail	TH 5	34500	16	44	51	46.00	-93	33	32.04		12	N	N	N
10X07	44.8038028	-93.8897861	airmap	24	55	55	20	20	0	0	15	2001	County Ditch 10	TH 25	1850	06	44	48	13.69	-93	53	23.23		13	N	N	N
13005	45.5132333	-92.8536694	airmap	24	55	55	20	20	0	0	15	1994	SUNRISE RIVER	TH 95	3202	06	45	30	47.64	-92	51	13.21		1	8	8	7
19X01	44.6548778	-93.1369083	airmap	24	55	55	20	20	0	0	15	1996	STREAM	TH 3 SIDE RD	1	19	44	39	17.56	-93	8	12.87		13	N	N	N
19X02	44.6454111	-92.7724694	airmap	24	55	55	20	20	0	0	15	2004	STREAM	OTERO DR (TH 316)	10	02	44	38	43.48	-92	46	20.89		13	N	N	N
19X05	44.5722389	-92.8732694	airmap	24	55	55	20	20	0	0	15	2005	DITCH	TH 20 SIDE ROAD	40	09	44	34	20.06	-92	52	23.77		13	N	N	N
19X07	44.5432139	-93.1367028	airmap	24	55	55	20	20	0	0	15	2017	DITCH	TH 3	4950	06	44	32	35.57	-93	08	12.13		13	N	N	N
27012	44.9557083	-93.34745	airmap	48	45	65	0	20	10	0	15	1978	TH 100	Ped at 26th St	1		44	57	20.55	-93	20	50.82		7	7	6	7
27035	44.9839278	-93.403725	airmap	24	55	55	20	20	0	0	15	1965	BASSETT CREEK	TH 55 WB on ramp	2000	14	44	59	02.14	-93	24	13.41		13	N	N	N
27036	44.9830222	-93.4034611	airmap	24	55	55	20	20	0	0	15	1965	BASSETT CREEK	TH 55 EB off ramp	4500	14	44	58	58.88	-93	24	12.46		13	N	N	N
27199	44.9923444	-93.6176	airmap	48	55	55	20	20	0	0	15	2007	US 12; BNSF RR	CSAH 6	1	16	44	59	32.44	-93	37	03.36		1	7	7	7
27220	45.1230889	-93.3193194	airmap	48	45	65	0	20	10	0	15	1998	TH 610	Pedestrian	1		45	07	23.12	-93	19	09.55		7	7	7	7
27226	44.9850222	-93.3559028	airmap	48	55	55	20	20	0	0	15	1985	CP RAIL (Frontage Rd)	TH 55 N Frontage	4750	19	44	59	06.08	-93	21	21.25		1	8	7	7
27251	45.1445	-93.4984667	airmap	24	55	55	20	20	0	0	15	2015	I 94; RUSH CREEK	105TH AVE N	520	19	45	08	40.20	-93	29	54.48		1	8	8	8
27259	44.9879917	-93.34935	airmap	24	55	55	20	20	0	0	15	2000	UP RR; KQRS DRIVE	TH 100 WEST FRONT	1	19	44	59	16.77	-93	20	57.66		1	7	8	8
27265	44.9878667	-93.349075	airmap	24	55	55	20	20	0	0	15	2000	UP RR; KQRS DR	TH 100 NB ON RAMP	1	12	44	59	16.32	-93	20	56.67		1	7	8	7
27272	44.980325	-93.5512306	airmap	48	55	55	20	20	0	0	15	2003	TH 12; BNSF RR	LUCE LINE TRAIL	1		44	58	49.17	-93	33	04.43		3	7	7	5
27273	44.9855	-93.5738444	airmap	24	55	55	20	20	0	0	15	2004	TH 12; BNSF RR	BROWN ROAD	4400	17	44	59	07.80	-93	34	25.84		1	7	8	7
27274	44.9853889	-93.5840389	airmap	48	55	55	20	20	0	0	15	2004	TH 12; BNSF RR	WILLOW DRIVE S	4150	17	44	59	07.40	-93	35	02.54		1	7	7	7
27275	44.9855	-93.5942472	airmap	24	55	55	20	20	0	0	15	2004	TH 12; BNSF RR	OLD CRYSTAL BAY RD	2750	17	44	59	07.80	-93	35	39.29		1	8	8	8
27278	44.9826583	-93.558575	airmap	48	55	55	20	20	0	0	15	2005	TH 12; BNSF RR	TRAIL A	1		44	58	57.57	-93	33	30.87		1	8	7	5
27407	44.8902056	-93.2639917	airmap	24	55	55	20	20	0	0	15	2008	LEGION LAKE	TRAIL	1		44	53	24.74	-93	15	50.37		2	8	8	8
27409	44.9790306	-93.2451556	airmap	48	45	45	20	0	10	0	15	2008	MISS R, W R PKWY, RD; RR	I 35W SB	70000	11	44	58	44.51	-93	14	42.56		7	7	7	7
27410	44.9789806	-93.2445972	airmap	24	45	45	20	0	10	0	15	2008	MISS R, W R PKWY, RD; RR	I 35W NB	70000	11	44	58	44.33	-93	14	40.55		7	7	8	7
27624E	44.7919111	-93.404625	airmap	48	55	55	20	20	0	0	15	1993	BFWR 102 (TRAIL)	US 169 SB off ramp	2000	12	44	47	30.88	-93	24	16.65		1	7	6	5
27717	45.0337194	-93.2869194	airmap	48	45	45	20	0	10	0	15	1980	Shingle Creek	I 94	124000	11	45	2	1.39	-93	17	12.91		7	7	7	7
27786	44.9618833	-93.3449639	airmap	48	55	55	20	20	0	0	15	1989	BNSF RR; CITY STREETS	TH 100 W FRONTAGE	4225	12	44	57	42.78	-93	20	41.87		1	7	7	7
27810	45.0365528	-93.2858972	airmap	48	45	45	20	0	10	0	15	1982	PED PATH	I 94	124000	11	45	02	11.59	-93	17	09.23		7	8	7	7
27816P	44.9837472	-93.2763806	airmap	48	55	55	20	20	0	0	15	1982	BNSF RR	PEDESTRIAN	1	16	44	59	01.49	-93	16	34.97		1	7	6	8
27831A	44.9716694	-93.2972722	airmap	48	60	80	0	20	0	25	15	1967	Dunwoody Blvd	I 394 WB on ramp	3300	11	44	58	18.01	-93	17	50.18		1	6	6	6
27831C	44.9752139	-93.2910056	airmap	48	60	80	0	0	10	25	25	1967	EB; WB I 94	I 394 WB ON RAMP	30000	11	44	58	30.77	-93	17	27.62		7	6	6	5
27866	44.9731861	-93.2970278	airmap	48	55	55	20	20	0	0	15	1972	UP RAIL	PED Linden Avenue	1		44	58	23.47	-93	17	49.30		1	6	6	6
27904	45.0726639	-93.30885	airmap	48	55	55	20	10	10	0	15	1980	Shingle Creek	I 94 WB on ramp	5400	11	45	04	21.59	-93	18	31.86		7	7	7	7
27908	45.1082472	-93.4666361	airmap	48	55	55	20	20	0	0	15	1973	ELM CREEK	PEDESTRIAN	1		45	06	29.69	-93	27	59.89		1	6	7	7
27R11	45.1340306	-93.4476556	airmap	24	55	55	20	20	0	0	15	2017	ELM CREEK	TH 610 WB	1	14	45	08	02.51	-93	26	51.56		1	8	8	8
27R15	45.1348472	-93.4502889	airmap	24	55	55	20	20	0	0	15	2005	MN 610/CSAH 81 RAILROAD	PEDESTRIAN	1		45	08	05.45	-93	27	01.04		1	8	8	8
27R19	45.1058417	-93.3932639	airmap	24	55	55	20	20	0	0	15	2008	CSAH 81, RAMP; BNSF RR	US 169 NB	1	12	45	06	21.03	-93	23	35.75		1	8	8	8
27R23	45.105675	-93.3929056	airmap	48	55	55	20	20	0	0	15	2008	CSAH 81; BNSF RR	RAMP(169NB TO 109)	1	12	45	06	20.43	-93	23	34.46		1	7	7	7
27R24	45.1063583	-93.3934639	airmap	24	55	55	20	20	0	0	15	2008	CSAH 81, BNSF RR, RAMP	RAMP TO US 169 SB	1	16	45	06	22.89	-93	23	36.47		1	8	8	8
27V66	44.8884139	-93.2952389	airmap	24	45	65	0	20	10	0	15	2007	I 35W ON RAMP	I 35W OFF RAMP	1	11	44	53	18.29	-93	17	42.86		7	8	8	7
27V73	44.8899389	-93.2902611	airmap	24	45	65	0	20	10	0	15	2007	RAMP (62 EB TO LYNDALE)	RAMP (35W TO 62)	1	11	44	53	23.78	-93	17	24.94		7	8	8	8
27V74B	44.8899278	-93.2832194	airmap	24	55	55	20	20	0	0	15	2007	CP RAIL	MN 62 EB	1	12	44	53	23.74	-93	16	59.59		1	7	8	7
27V74C	44.890475	-93.2833028	airmap	24	55	55	20	20	0	0	15	2007	CP RAIL	MN 62 WB	1	12	44	53	25.71	-93	16	59.89		1	8	8	8
27V75	44.8907806	-93.2781	airmap	24	45	65	0	20	10	0	15	2008	NICOLLET AVE SO	RAMP (35W TO 62WB)	1	11	44	53	26.81	-93	16	41.16		7	8	8	7
27W15	45.1379667	-93.4581667	airmap	24	55	55	20	20	0	0	15	2017	RAILROAD	TH 610	1	12	45	08	16.68	-93	27	29.40		1	8	8	8
27X01	44.8612056	-93.4441389	airmap	24	55	55	20	20	0	0	15	1998	County Ditch 43	TH 5 EB on ramp	1	19	44	51	40.34	-93	26	38.9		13	N	N	N
27X03	44.9150389	-93.2131417	airmap	24	45	45	20	0	10	0	15	1999	MINNEHAHA CREEK	TH 55	22600	14	44	54	54.14	-93	12	47.31		12	N	N	N
27X08	45.1056417	-93.3934333	airmap	24	55	55	20	20	0	0	15	2008	DITCH	US 169 R-O-W	1		45	06	20.31	-93	23	36.36		13	N	N	N
4190	44.8851278	-93.1735611	airmap	48	45	45	20	0	10	0	15	1926	MINN RIVER, RR, STREET	TH 55	42500	12	44	53	6.46	-93	10	24.82	V	12	6	7	7
4380	45.1916583	-93.3953056	airmap	48	45	45	20	0	10	0	15	1929	Mississippi River	US 169	46000	14	45	11	29.97	-93	23	43.1	V	12	7	7	7
4774	44.5409667	-92.8945694	airmap	24	55	55	20	20	0	0	15	1931	Pine Creek	TH 20	3050	06	44	32	27.48	-92	53	40.45		13	N	N	N
4775	44.5742694	-92.8725889	airmap	24	55	55	20	20	0	0	15	1931	STREAM	TH 20	2800	06	44	34	27.37	-92	52	21.32		13	N	N	N
4860	44.6535917	-92.8535472	airmap	24	55	55	20	20	0	0	15	1929	STREAM	US 61	3500	06	44	39	12.93	-92	51	12.77		13	N	N	N
5642A	45.01	-93.35	airmap	24	55	55	20	20	0	0	15	2000	Bassett Creek	TH 100	1	19	45	0	36	-93	21	0		13	N	N	N
5680	45.5133667	-92.8931667	airmap	24	55	55	20	20	0	0	15	1937	N BR SUNRISE RIVER	TH 95	3202	06	45	30	48.12	-92	53	35.40		13	N	N	N
62017	44.9467	-93.0789861	airmap	24	45	45	20	0	10	0	15	2014	MISS R, RR; STREETS	US 52 SB	36500	12	44	56	48.12	-93	04	44.35		7	8	8	7
62018	44.94645	-93.0788111	airmap	24	45	45	20	0	10	0	15	2010	MISS R, RR; STREETS	US 52 NB	36500	12	44	56	47.22	-93	04	43.72		7	6	8	7
62610	44.9632389	-93.091125	airmap	24	55	55	20	20	0	0	15	2015	BNSF RR; MINNEHAHA AV	FRONTAGE RD	1	16	44	57	47.66	-93	05	28.05		1	8	8	8
62913	45.0425417	-92.9847194	airmap	48	45	65	0	20	10	0	15	2001	CENTURY AVE (TH 120)	PED	1		45	02	33.15	-92	59	04.99	W	12	7	7	7
62926	44.9685472	-93.0901556	airmap	24	55	55	20	20	0	0	15	2015	BNSF RR	NW RAMP	0	11	44	58	6.77	-93	5	24.56		1	7	8	7
62J08	44.9550583	-93.0965806	airmap	24	55	55	20	20	0	0	15	1998	PEDESTRAIN PATH	14TH STREET	1	19	44	57	18.21	-93	5	47.69		13	N	N	N
62X02X	44.9089806	-93.1427222	airmap	24	55	55	20	20	0	0	15	2001	Ped Trail	I 35E NB off Ramp	1	11	44	54	32.33	-93	8	33.80		13	N	N	N
62X02Y	44.9088222	-93.1432111	airmap	24	55	55	20	20	0	0	15	2001	Ped Trail	35E SB on ramp	1	11	44	54	31.76	-93	8	35.56		13	N	N	N
62X04	45.0946722	-93.18705	airmap	24	55	55	20	20	0	0	15	2015	RICE CREEK	I 35W RAMP	1	01	45	05	40.82	-93	11	13.38		13	N	N	N
6991	44.7916722	-93.7881	airmap	24	55	55	20	20	0	0	15	1940	CARVER CREEK	TH 284	3300	06	44	47	30.02	-93	47	17.16		13	N	N	N
70042	44.5981417	-93.5957417	airmap	24	55	55	20	20	0	0	15	1999	Raven Stream	TH 21	4950	06	44	35	53.31	-93	35	44.67		1	7	8	8
82005	45.2370194	-92.7688	airmap	48	55	55	20	20	0	0	15	1986	WC LIMITED RR	TH 95	4250	06	45	14	13.27	-92	46	07.68		1	5	7	7
82020	44.8322111	-92.9656833	airmap	48	55	55	20	20	0	0	15	1982	CP RR; FRONTAGE RD	CSAH 39 (US61)	2150	16	44	49	55.96	-92	57	56.46		1	7	7	7
82032	44.8779639	-93.0029	airmap	24	55	55	20	20	0	0	15	2003	US 61 7TH AVE BN; CP RR	PED	1		44	52	40.67	-93	00	10.44		1	7	8	7
82046	45.03625	-92.9451972	airmap	24	55	55	20	20	0	0	15	2013	DNR GATEWAY TRAIL	60TH ST N	1	16	45	02	10.50	-92	56	42.71		1	8	8	8
82855	44.8828611	-93.0158611	airmap	24	45	45	20	0	10	0	15	2008	MISSISSIPPI R; UP RR	I 494 EB	44500	11	44	52	58.30	-93	00	57.10		7	8	8	7
82856	44.8831472	-93.0159222	airmap	48	45	45	20	0	10	0	15	2003	MISSISSIPPI R; UP RR	I 494 WB	89000	11	44	52	59.33	-93	00	57.32		7	8	6	6
8707	44.5472306	-92.9946583	airmap	24	55	55	20	20	0	0	15	1947	STREAM	TH 56	2450	06	44	32	50.03	-92	59	40.77		13	N	N	N
8708	44.5586278	-92.9948278	airmap	24	55	55	20	20	0	0	15	1947	STREAM	TH 56	2350	06	44	33	31.06	-92	59	41.38		13	N	N	N
8709	44.5614472	-92.9948583	airmap	24	55	55	20	20	0	0	15	1947	DITCH	TH 56	2350	06	44	33	41.21	-92	59	41.49		13	N	N	N
8710	44.5986222	-92.9931333	airmap	24	55	55	20	20	0	0	15	1947	STREAM	TH 56	2350	06	44	35	55.04	-92	59	35.28		13	N	N	N
8720	45.0757861	-92.8079528	airmap	24	55	55	20	20	0	0	15	1949	BROWNS CREEK	TH 96	3350	16	45	4	32.83	-92	48	28.63		13	N	N	N
8821	44.6302722	-93.0251389	airmap	24	55	55	20	20	0	0	15	1925	STREAM	TH 50	4200	06	44	37	48.98	-93	01	30.50		13	N	N	N
90386	44.9563861	-93.0772778	airmap	24	45	45	20	0	10	0	15	1884	RCRRA	TH 5 East 7th St	24300	16	44	57	22.99	-93	04	38.20	U	12	N	N	N
91168	44.6303556	-93.0571056	airmap	24	55	55	20	20	0	0	15	1925	STREAM	TH 50	4200	06	44	37	49.28	-93	3	25.58		13	N	N	N
91169	44.6303583	-93.0514444	airmap	24	55	55	20	20	0	0	15	1925	STREAM	TH 50	4200	06	44	37	49.29	-93	03	05.20		13	N	N	N
91179	45.3350944	-93.0053722	airmap	24	55	55	20	20	0	0	15	1967	S BR SUNRISE RIVER	I 35 SB ON RAMP	1000	01	45	20	06.34	-93	00	19.34		13	N	N	N
91180	45.335275	-93.0039667	airmap	24	55	55	20	20	0	0	15	1967	S BR SUNRISE RIVER	I 35 NB OFF RAMP	1000	01	45	20	06.99	-93	00	14.28		13	N	N	N
91225	44.5602306	-93.5016778	airmap	24	55	55	20	20	0	0	15	1971	DITCH	TH 13	4100	06	44	33	36.83	-93	30	6.04		15	N	N	N
91334	44.9869528	-93.2880778	airmap	24	55	55	20	10	10	0	15	1915	Bassett Creek	I 94 E Frontage Rd	9400	16	44	59	13.03	-93	17	17.08	U	12	N	N	N
9217E	44.8618583	-93.1974111	airmap	48	70	70	20	0	0	25	25	1981	Minnesota River	I 494 EB	46000	11	44	51	42.69	-93	11	50.68		1	6	6	5
9217W	44.8618806	-93.1975028	airmap	48	70	70	20	0	0	25	25	1981	Minnesota River	I 494 WB	46000	11	44	51	42.77	-93	11	51.01		1	6	6	5
93060	44.8937694	-93.0431972	airmap	24	55	55	20	20	0	0	15	1974	Pedestrian Underpass	MSAS 105 (3 ST N)	1600	19	44	53	37.57	-93	02	35.51		15	N	N	N
94278	44.9841111	-93.2929917	airmap	24	55	55	20	20	0	0	15	1914	Bassett Creek	TH 55 S Frontage	1	19	44	59	2.80	-93	17	34.77		13	N	N	N
94279	44.9841167	-93.2928917	airmap	24	55	55	20	20	0	0	15	1939	Bassett Creek	TH 55 N Frontage	1	19	44	59	02.82	-93	17	34.41		13	N	N	N
9474	45.0395278	-93.1914222	airmap	48	55	55	20	20	0	0	15	1963	MC RAIL (COUNTY 88)	TH 888A NB; 35W	4400	16	45	02	22.30	-93	11	29.12		1	6	7	5
9489	44.8963389	-93.1797167	airmap	48	45	65	0	20	10	0	15	1962	West 7th St TH 5	Miss R Blvd SB	3350	16	44	53	46.82	-93	10	46.98		7	7	7	6
9490	44.89645	-93.1795722	airmap	48	45	65	0	20	10	0	15	1962	West 7th St TH 5	Miss R Blvd NB	3350	14	44	53	47.22	-93	10	46.46		7	7	6	6
96686	44.6303639	-93.0454944	airmap	24	55	55	20	20	0	0	15	1989	S BR Vermillion River	TH 50	4200	06	44	37	49.31	-93	02	43.78		13	N	N	N
96735	44.8606528	-93.4451139	airmap	24	55	55	20	20	0	0	15	1996	County Ditch 43	TH 5 Bus Ramp	1	19	44	51	38.35	-93	26	42.41		13	N	N	N
97279X	44.8628	-93.4432917	airmap	24	55	55	20	20	0	0	15	1998	County Ditch 43 TH 5	Plaza Drive	1	19	44	51	46.08	-93	26	35.85		13	N	N	N
97680	44.8839556	-93.168625	airmap	24	45	65	0	20	10	0	15	1993	BIKEWAY	TH 13	4250	17	44	53	02.24	-93	10	07.05		12	N	N	N
02003	45.1699056	-93.2941444	airmap	24	35	35	20	0	0	0	15	2009	BNSF Railroad	US 10 WB	43000	12	45	10	11.66	-93	17	38.92		1	8	8	8
02004	45.169625	-93.2941194	airmap	24	35	35	20	0	0	0	15	2009	BNSF Railroad	US 10 EB	43000	12	45	10	10.65	-93	17	38.83		1	8	8	8
02005	45.0568583	-93.2475583	airmap	24	35	55	0	20	0	0	15	2010	MN 65	PEDESTRIAN	1		45	03	24.69	-93	14	51.21	A	2	6	8	8
02006	45.1926472	-93.073075	airmap	24	35	55	0	20	0	0	15	2013	I 35W	PED TRAIL	1		45	11	33.53	-93	04	23.07		5	8	8	8
02017	45.0444611	-93.2632056	airmap	48	35	55	0	20	0	0	15	1967	MN 47	PED @ 49th Ave	1		45	02	40.06	-93	15	47.54	_	1	6	6	6
02022	45.1124806	-93.2430194	airmap	24	35	55	0	20	0	0	15	1973	MN 65; FRONTAGE RD	PED @ 80th AVE NE	1		45	06	44.93	-93	14	34.87	_	1	7	8	7
02023	45.1387417	-93.2905972	airmap	48	35	35	20	0	0	0	15	1986	East River Road	MN 610 WB	33500	12	45	08	19.47	-93	17	26.15	_	1	7	7	6
02025	45.1399028	-93.287925	airmap	24	35	35	20	0	0	0	15	1986	BNSF Railroad	MN 610 WB	34500	12	45	08	23.65	-93	17	16.53	_	1	6	8	7
02026	45.139725	-93.28785	airmap	24	35	35	20	0	0	0	15	1986	BNSF Railroad	MN 610 EB	34500	12	45	08	23.01	-93	17	16.26	_	1	7	8	6
02034	45.150725	-93.273675	airmap	48	35	55	0	10	10	0	15	1996	MN 47 SB	US 10 EB On Ramp	6000	16	45	09	02.61	-93	16	25.23	_	7	7	7	6
02037E	45.143475	-93.2667306	airmap	48	25	45	0	0	10	0	15	1997	UNIVERSITY AVE; MN 610	US 10 EB	25500	12	45	08	36.51	-93	16	0.23	_	7	7	7	7
02037W	45.1434889	-93.2664722	airmap	48	25	45	0	0	10	0	15	1997	UNIVERSITY AVE; MN 610	US 10 WB	25500	12	45	08	36.56	-93	15	59.30	_	7	7	7	7
02038	45.2877222	-93.4188222	airmap	48	45	45	20	10	0	0	15	2000	Trott Brook	TH 47	7200	16	45	17	15.80	-93	25	07.76	_	9	7	7	7
02044	45.1409556	-93.2563167	airmap	48	45	65	0	20	10	0	15	1997	US 10	Pedestrian	1		45	08	27.44	-93	15	22.74	_	7	7	5	7
02049	45.3801917	-93.3810278	airmap	24	45	45	20	10	0	0	15	2001	Seelye Brook	TH 47	6300	06	45	22	48.69	-93	22	51.70		1	7	8	8
02052	45.2043694	-93.2344722	airmap	24	35	55	0	20	0	0	15	2007	MN 65	129 AVE NE	1	19	45	12	15.73	-93	14	04.1		1	7	8	8

02562	45.1756639	-93.3026806	airmap	48	35	55	0	20	0	0	15	1998	US 10	Creek Meadows Dr	3500	19	45	10	32.39	-93	18	09.65		1	7	7	7
02587	45.0687611	-93.268325	airmap	24	35	55	0	20	0	0	15	2017	I 694	MAIN ST TRAIL	1		45	4	7.54	-93	16	5.97		3	8	8	8
02801	45.2147361	-93.034325	airmap	48	45	65	0	20	0	0	25	1967	I 35W	CSAH 54	3050	07	45	12	53.05	-93	02	03.57		1	6	6	5
02802	45.1965	-93.0298222	airmap	48	35	55	0	20	0	0	15	1965	I 35E	80TH ST	1350	08	45	11	47.40	-93	01	47.36		1	6	6	6
02807	45.0688583	-93.2716444	airmap	48	35	55	0	20	0	0	15	1987	I 694	BNSF RR	1		45	04	07.89	-93	16	17.92		6	7	7	7
02J30	45.26545	-93.4153056	airmap	24	45	45	20	10	0	0	15	2006	TRAIL	MN 47	10100	16	45	15	55.62	-93	24	55.10		13	N	N	N
02X01	45.2994917	-93.4102639	airmap	24	45	45	20	10	0	0	15	2000	Ford Brook	TH 47	6900	06	45	17	58.17	-93	24	36.95		13	N	N	N
02X02	45.3112333	-93.4059917	airmap	24	45	45	20	10	0	0	15	2000	Ford Brook	TH 47	5300	06	45	18	40.44	-93	24	21.57		13	N	N	N
02X03	45.0931556	-93.2435306	airmap	24	35	35	20	0	0	0	15	2001	ped	TH 65	34000	14	45	5	35.36	-93	14	36.71		13	N	N	N
02X04	45.1547	-93.1695639	airmap	24	35	35	20	0	0	0	15	2004	CO DITCH 53-62	I 35W	56000	11	45	9	16.92	-93	10	10.43		13	N	N	N
10003	44.859725	-93.6657944	airmap	24	45	45	20	10	0	0	15	2012	LK MINNETONKA LRT TRL	TH5(ARBORETUM BVD)	12200	16	44	51	35.01	-93	39	56.86		1	8	8	7
10006	44.837075	-93.6019222	airmap	48	55	55	20	10	0	0	25	1965	TCW RR	TH 41	19100	16	44	50	13.47	-93	36	06.92		1	6	6	5
10009	44.8592306	-93.5417028	airmap	48	45	45	20	10	0	0	15	1964	TCW RR	TH 5 EB	19750	16	44	51	33.23	-93	32	30.13		1	6	7	6
10010	44.8593472	-93.5413361	airmap	48	45	45	20	10	0	0	15	1990	TCW RR	TH 5 WB	19750	16	44	51	33.65	-93	32	28.81		1	7	7	7
10011	44.7944361	-93.6018444	airmap	24	45	45	20	10	0	0	15	2004	Clay Lake Ravine	TH 41	12500	14	44	47	39.97	-93	36	06.64		1	7	8	6
10012	44.7827611	-93.5991278	airmap	24	45	45	20	10	0	0	15	2007	Minnesota River	TH 41	12500	14	44	46	57.94	-93	35	56.86		1	7	8	8
10017	44.7910389	-93.6318444	airmap	24	35	55	0	20	0	0	15	2008	US 212	CNTY RD 140	750	07	44	47	27.74	-93	37	54.64		1	8	8	8
10019	44.7772611	-93.6425333	airmap	24	35	55	0	20	0	0	15	2008	US 212	CSAH 11	1200	16	44	46	38.14	-93	38	33.12		1	8	8	8
10027	44.8005833	-93.6297611	airmap	24	45	45	20	10	0	0	15	2008	CREEK RD; CHASKA CREEK	US 212 WB	7650	14	44	48	02.10	-93	37	47.14		1	8	8	7
10028	44.8004694	-93.6294111	airmap	24	45	45	20	10	0	0	15	2008	CREEK RD; CHASKA CREEK	US 212 EB	7650	14	44	48	01.69	-93	37	45.88		1	8	8	7
10031	44.8136056	-93.6124639	airmap	24	35	55	0	20	0	0	15	2007	US 212	BAVARIA ROAD	4800	17	44	48	48.98	-93	36	44.87		1	7	8	7
10033	44.8146833	-93.6073139	airmap	48	45	45	20	10	0	0	15	2007	EAST (CHASKA) CREEK	US 212 WB	15000	14	44	48	52.86	-93	36	26.33		1	7	7	7
10034	44.8144556	-93.6068806	airmap	48	45	45	20	10	0	0	15	2007	EAST (CHASKA) CREEK	US 212 EB	15000	14	44	48	52.04	-93	36	24.77		1	7	7	7
10035	44.8174417	-93.59675	airmap	48	45	45	20	10	0	0	15	2007	HUNDERTMARK CREEK	US 212 WB	15000	14	44	49	02.79	-93	35	48.3		1	7	7	8
10036	44.8172389	-93.5965944	airmap	48	45	45	20	10	0	0	15	2007	HUNDERTMARK CREEK	US 212 EB	15000	14	44	49	02.06	-93	35	47.74		1	7	7	7
10045	44.8253833	-93.56305	airmap	48	35	55	0	20	0	0	15	2007	BLUFF CRK DR	US 212 WB	1	14	44	49	31.38	-93	33	46.98		1	7	7	7
10046	44.8251194	-93.56295	airmap	24	35	55	0	20	0	0	15	2007	BLUFF CRK DR	US 212 EB	1	14	44	49	30.43	-93	33	46.62		1	7	8	8
10048	44.8199722	-93.5880972	airmap	48	35	55	0	20	0	0	15	2007	US 212	PED/BIKE	1		44	49	11.90	-93	35	17.15		5	7	7	7
10051	44.83015	-93.5578306	airmap	24	35	35	20	0	0	0	15	2007	BLUFF CREEK(MAIN BRANCH)	US 212 WB	29000	14	44	49	48.54	-93	33	28.19		1	7	8	8
10052	44.8298861	-93.5576861	airmap	24	35	35	20	0	0	0	15	2007	BLUFF CREEK(MAIN BRANCH)	US 212 EB	29000	14	44	49	47.59	-93	33	27.67		1	7	8	7
10053	44.8121111	-93.6176	airmap	24	45	45	20	10	0	0	15	2007	KOEHNEN CREEK	US 212 WB	11500	14	44	48	43.60	-93	37	03.36		1	8	8	8
10054	44.8118528	-93.6175222	airmap	24	45	45	20	10	0	0	15	2007	KOEHNEN CREEK	US 212 EB	11500	14	44	48	42.67	-93	37	03.08		1	8	8	8
10531	44.8606528	-93.5274417	airmap	48	35	55	0	20	0	0	15	1995	TH 5	PED	1		44	51	38.35	-93	31	38.79		1	7	7	7
10J11	44.8809056	-93.6316	airmap	24	45	45	20	10	0	0	15	2002	LAKE VIRGINIA TRAIL	TH 7	14000	14	44	52	51.26	-93	37	53.76		13	N	N	N
10J26	44.8368333	-93.5388806	airmap	24	45	45	20	10	0	0	15	2012	PED UNDERPASS	TH 101	5900	16	44	50	12.60	-93	32	19.97		13	N	N	N
10X03	44.8115528	-93.6021278	airmap	24	45	45	20	10	0	0	15	2001	PED	TH 41	16500	16	44	48	41.59	-93	36	07.66		13	N	N	N
10X05	44.8114972	-93.6021472	airmap	24	45	45	20	10	0	0	15	2001	Chaska Creek	TH 41	16500	14	44	48	41.39	-93	36	7.73		13	N	N	N
10X08	44.8514833	-93.761125	airmap	24	45	45	20	10	0	0	15	2004	PED	TH 5	16800	16	44	51	05.34	-93	45	40.05		13	N	N	N
10X16	44.8597528	-93.6658778	airmap	24	35	35	20	0	0	0	15	2011	PED TRAIL	TH 5	24700	16	44	51	35.11	-93	39	57.16		13	N	N	N
10X17	44.8774694	-93.5870444	airmap	24	45	45	20	10	0	0	15	2012	PED TRAIL	TH 41	14000	16	44	52	38.89	-93	35	13.36		13	N	N	N
10X19	44.8357583	-93.8071361	airmap	24	45	45	20	10	0	0	15	2015	PEDESTRIAN	TH 5	10700	16	44	50	08.73	-93	48	25.69		13	N	N	N
13004	45.3900806	-92.8191139	airmap	24	45	45	20	10	0	0	15	2005	CENTER LAKE CHANNEL	US 8	14360	02	45	23	24.29	-92	49	08.81		26	6	8	7
13519	45.4510028	-92.9893806	airmap	48	35	55	0	20	0	0	15	2006	I 35	CSAH 17	1300	08	45	27	03.61	-92	59	21.77		1	7	7	8
13806	45.5778278	-92.9925389	airmap	48	35	55	0	20	0	0	15	1967	I 35	CSAH 10	3650	07	45	34	40.18	-92	59	33.14		1	7	6	7
13807	45.6155056	-92.9923861	airmap	48	45	65	0	20	0	0	25	1967	I 35	CSAH 9	255	08	45	36	55.82	-92	59	32.59		1	6	6	5
13810	45.7167306	-92.9922139	airmap	48	35	55	0	20	0	0	15	1968	I 35	CSAH 3	190	08	45	43	0.23	-92	59	31.97		1	6	6	7
13811	45.6709556	-92.9923083	airmap	48	35	55	0	20	0	0	15	1970	I 35	CSAH 7	2000	07	45	40	15.44	-92	59	32.31		1	6	7	7
13J06	45.3751222	-92.8854917	airmap	24	45	45	20	10	0	0	15	2003	PED	US 8	16500	02	45	22	30.44	-92	53	07.77		13	N	N	N
19004	44.7468333	-92.8531111	airmap	24	25	45	0	0	10	0	15	2013	MISS R;2ND ST;N LOOP RD	US 61	29500	14	44	44	48.60	-92	51	11.20		24	6	8	6
19011	44.6012611	-92.9933556	airmap	48	35	55	0	20	0	0	15	1962	US 52	TH 50	4250	06	44	36	4.54	-92	59	36.08		9	7	7	6
19013	44.8197694	-93.2241222	airmap	48	35	35	20	0	0	0	15	1978	UP RR	TH 77 SB	47000	12	44	49	11.17	-93	13	26.84		1	7	6	7
19019	44.8979639	-93.0661611	airmap	48	35	55	0	20	0	0	15	1972	WENTWORTH AVE	US 52 SB	890	12	44	53	52.67	-93	03	58.18		1	7	7	7
19024	44.8251806	-93.06105	airmap	48	35	55	0	20	0	0	15	1992	TH 55	Barnes Ave CSAH 73	3300	16	44	49	30.65	-93	3	39.78		1	7	7	6
19025	44.9175528	-93.0638194	airmap	48	35	55	0	20	0	0	15	1973	US 52	PED @ Lewis St	1		44	55	03.19	-93	03	49.75		1	7	7	7
19033	44.6615056	-93.0074917	airmap	48	45	45	20	10	0	0	15	1978	Vermillion River	US 52 SB	13750	02	44	39	41.42	-93	0	26.97		1	6	6	6
19075	44.7244139	-92.8523472	airmap	48	35	35	20	0	0	0	15	1978	VERMILLION RIVER	US 61	26500	14	44	43	27.89	-92	51	08.45		1	6	6	6
19078	44.7966	-93.0381472	airmap	48	35	35	20	0	0	0	15	1978	UP RR	US 52 SB	23000	14	44	47	47.76	-93	2	17.33		1	7	7	6
19079	44.8019417	-93.0394278	airmap	48	35	35	20	0	0	0	15	1978	UP RR	US 52 SB	23000	14	44	48	6.99	-93	2	21.94		1	7	7	7
19083	44.8544528	-93.0597083	airmap	48	35	55	0	20	0	0	15	1990	US 52	65th Street	1600	19	44	51	16.03	-93	03	34.95		1	7	7	6
19085	44.8414917	-93.0596556	airmap	48	35	55	0	20	0	0	15	1991	US 52	75th Street	620	19	44	50	29.37	-93	03	34.76		1	6	7	7
19086	44.7242972	-93.1319889	airmap	48	35	55	0	20	0	0	15	1992	TH 3	CP RR	1		44	43	27.47	-93	07	55.16		5	6	7	7
19090	44.8781694	-93.1634444	airmap	48	35	55	0	20	0	0	15	1993	TH 55	Acacia Blvd	890	19	44	52	41.41	-93	9	48.40		1	7	7	7
19094	44.6497528	-93.1366667	airmap	48	45	45	20	10	0	0	15	2003	Vermillion River	TH 3	10100	16	44	38	59.11	-93	08	12.00		9	7	7	8
19095	44.5119139	-93.1455389	airmap	24	45	45	20	10	0	0	15	2003	Chub Creek	TH 3	5300	06	44	30	42.89	-93	08	43.94		1	6	8	8
19539	44.8608361	-93.1765667	airmap	24	35	55	0	20	0	0	15	2003	OTHER	PED TO CONN TO PED	1	19	44	51	39.01	-93	10	35.64		1	7	8	8
19548	44.9071056	-93.0657722	airmap	48	35	55	0	20	0	0	15	2004	US 52	PED	1		44	54	25.58	-93	03	56.78		1	7	7	7
19562	44.8374361	-93.1609028	airmap	24	35	55	0	20	0	0	15	2008	I 35E; ON RAMP (NB)	NORTHWOOD PKWY	4100	19	44	50	14.77	-93	09	39.25		1	8	8	8
19803	44.6947778	-93.2901222	airmap	48	35	35	20	0	0	0	15	1992	CP RR	I 35 SB	37000	11	44	41	41.20	-93	17	24.44		1	7	6	7
19804	44.730575	-93.2830417	airmap	48	35	55	0	20	0	0	15	1988	I 35	CRYSTAL LAKE ROAD	3900	17	44	43	50.07	-93	16	58.95		1	7	7	7
19805	44.6944694	-93.2900167	airmap	48	35	35	20	0	0	0	15	1965	CP RR	I 35 NB	37000	11	44	41	40.09	-93	17	24.06		1	7	6	7
19821	44.8580944	-93.1461222	airmap	48	35	55	0	20	0	0	15	1981	I 35E, NB COLL	CP RR	1		44	51	29.14	-93	08	46.04		6	7	6	6
19822	44.8749583	-93.1432639	airmap	48	35	55	0	20	0	0	15	1982	I 35E	Wagon Wheel Trail	700	19	44	52	29.85	-93	08	35.75		1	7	6	5
19825	44.8612417	-93.1762694	airmap	48	45	45	20	0	0	0	25	1973	TH 13; UP RR	I 494	86000	11	44	51	40.47	-93	10	34.57		1	6	6	5
19829	44.8617889	-93.1507417	airmap	48	35	55	0	20	0	0	15	1981	I 494, EB COL, EB RMP	CP RR	1		44	51	42.44	-93	09	02.67		6	7	6	7
19831	44.8611667	-93.1059583	airmap	48	35	55	0	20	0	0	15	1985	I 494	Delaware Avenue	2000	17	44	51	40.2	-93	06	21.45		1	6	6	6
19835	44.8619528	-93.0929944	airmap	48	35	55	0	20	0	0	15	1985	I 494	60th St. Pieper Rd	500	19	44	51	43.03	-93	05	34.78		1	6	6	7
19841	44.6669167	-93.2940833	airmap	48	35	55	0	20	0	0	15	1965	I 35	195TH ST	675	19	44	40	0.90	-93	17	38.70		1	7	7	7
19847	44.6729917	-93.2942056	airmap	48	35	35	20	0	0	0	15	1965	LAKE MARION	I 35 SB	32000	11	44	40	22.77	-93	17	39.14		9	7	7	6
19848	44.6729889	-93.2938833	airmap	48	35	35	20	0	0	0	15	1965	LAKE MARION	I 35 NB	32000	11	44	40	22.76	-93	17	37.98		9	7	7	7
19861	44.8655472	-93.1449056	airmap	48	35	55	0	20	0	0	15	1982	I 35E, COLL, RAMPS	Mendota Heights Rd	3750	17	44	51	55.97	-93	08	41.66		1	6	7	5
19896	44.8804806	-93.024475	airmap	48	35	35	20	0	0	0	15	1988	UP Railroad Hardman Ave	I 494	85000	11	44	52	49.73	-93	01	28.11		1	6	6	6
19899	44.8645889	-93.144975	airmap	48	45	65	0	20	0	0	25	1983	I 494/I 35E NORTH RAMP	WB 494 TO SB 35E	4000	11	44	51	52.52	-93	08	41.91		1	6	6	5
19901	44.8609472	-93.1765444	airmap	48	35	55	0	20	0	0	15	1982	TH 13	PED @ I 494	1		44	51	39.41	-93	10	35.56		1	7	6	7
19R02	44.74945	-93.0341417	airmap	24	45	45	20	10	0	0	15	2003	UP RAIL	US 52 NB	17750	14	44	44	58.02	-93	2	2.91		1	7	8	8
19R03	44.7494917	-93.0344306	airmap	24	35	35	20	0	0	0	15	2003	UP RAIL	US 52 SB	35500	14	44	44	58.17	-93	2	3.95		1	7	8	8
19R05	44.617875	-92.9947583	airmap	48	35	55	0	20	0	0	15	2006	US 52	CSAH 47	2550	06	44	37	04.35	-92	59	41.13		1	7	7	6
19X03	44.6989694	-92.8247833	airmap	24	45	45	20	10	0	0	15	2004	STREAM	TH 316	9100	02	44	41	56.29	-92	49	29.22		13	N	N	N
19X04	44.6615056	-92.7749333	airmap	24	45	45	20	10	0	0	15	2004	STREAM	TH 316	5900	02	44	39	41.42	-92	46	29.76		13	N	N	N
19X06	44.6497528	-93.1366667	airmap	24	45	45	20	10	0	0	15	2013	PED WALKWAY	TH 3	13700	16	44	38	59.11	-93	08	12.00		13	N	N	N
2440	44.9834167	-93.2588583	airmap	48	70	90	0	10	10	25	25	1917	MISS RVR, CITY ST	TH 65 (3RD AVE S)	15500	16	44	59	0.3	-93	15	31.89	V	12	5	4	4
27003	44.9699528	-93.2876361	airmap	48	35	55	0	20	0	0	15	1988	I 94, LYNDALE; HENN AVE	PED AT WHITNEY	1		44	58	11.83	-93	17	15.49		3	8	7	8
27015	44.9926944	-93.2502278	airmap	48	45	45	20	10	0	0	15	1981	BNSF RR	TH 65(Central Ave)	18100	16	44	59	33.70	-93	15	0.82		1	6	6	6
27019	45.227075	-93.5526667	airmap	48	35	35	20	0	0	0	15	1993	Crow River	TH 101 SB	22250	02	45	13	37.47	-93	33	09.60		1	7	7	7
27020	45.2269972	-93.5523222	airmap	48	35	35	20	0	0	0	15	1967	Crow River	TH 101 NB	22250	02	45	13	37.19	-93	33	08.36		1	6	6	6
27027	44.8930472	-93.1829083	airmap	48	35	55	0	20	0	0	15	1961	TH 5	FT SNELLING PARK	1		44	53	34.97	-93	10	58.47		8	6	6	6
27028	44.8442778	-93.2468028	airmap	48	35	55	0	20	0	0	15	1978	TH 77	PED AT 88TH ST	1		44	50	39.40	-93	14	48.49		1	7	6	7
27031A	44.9782333	-93.3431944	airmap	48	35	55	0	20	0	0	15	1989	to Glenwood Ave	TH 100 NB off ramp	1100	12	44	58	41.64	-93	20	35.50		1	7	6	5
27031B	44.9782722	-93.3430389	airmap	48	35	55	0	20	0	0	15	1989	from Glenwood Ave	TH 100 NB on ramp	1100	12	44	58	41.78	-93	20	34.94		1	7	6	5
27038A	45.0508333	-93.3222972	airmap	48	35	55	0	20	0	0	15	1976	TH 100	Ped Brooklyn Blvd	1		45	03	03.00	-93	19	20.27		1	8	7	7
27038B	45.0511028	-93.3220222	airmap	48	35	55	0	20	0	0	15	1976	TH 100	Ped Brooklyn Blvd	1		45	03	03.97	-93	19	19.28		1	8	7	7
27039	45.0557	-93.314325	airmap	48	35	35	20	0	0	0	15	1991	Shingle Creek	TH 100 SB	31000	12	45	03	20.52	-93	18	51.57		9	7	7	7
27040	45.0554889	-93.3143083	airmap	48	35	35	20	0	0	0	15	1964	Shingle Creek	TH 100 NB	31000	12	45	03	19.76	-93	18	51.51		9	7	7	7
27044	45.0864722	-93.734825	airmap	48	45	45	20	10	0	0	15	1986	Crow River	TH 55	18100	02	45	05	11.30	-93	44	05.37		1	7	6	6
27048	44.8570611	-93.2472861	airmap	48	35	55	0	20	0	0	15	1988	TH 77; RAMPS	SB CD TO LINDAU LN	3450	12	44	51	25.42	-93	14	50.23		1	6	6	7
27050	44.8576111	-93.2465694	airmap	48	35	55	0	20	0	0	15	1988	81st Street	TH 77 NB on ramp	3480	12	44	51	27.4	-93	14	47.65		1	7	6	6
27055	45.0276417	-93.2639917	airmap	48	35	55	0	20	0	0	15	1998	TH 47 (University Ave)	St Anthony Pkwy	4400	16	45	01	39.51	-93	15	50.37		1	7	7	7
27059	45.0293972	-93.2642361	airmap	48	45	45	20	10	0	0	15	1997	CP RAIL	TH 47	14700	16	45	01	45.83	-93	15	51.25		1	7	7	6
27060	44.8479917	-93.2474278	airmap	48	35	55	0	20	0	0	15	1978	TH 77	86 ST	4000	17	44	50	52.77	-93	14	50.74		1	6	6	6
27068	44.9347083	-93.3952333	airmap	48	35	35	20	0	0	0	15	1981	Recreation Trail	TH 7	37500	14	44	56	04.95	-93	23	42.84		1	6	6	7
27072	45.0199944	-93.2628861	airmap	48	45	45	20	10	0	0	15	1998	BNSF RR	TH 47	13500	16	45	01	11.98	-93	15	46.39		1	6	7	6
27075	44.98475	-93.3559667	airmap	24	45	45	20	10	0	0	15	1997	CP RAIL	TH 55 WB	16750	14	44	59	05.1	-93	21	21.48		1	7	8	7
27076	44.9846222	-93.3558278	airmap	24	45	45	20	10	0	0	15	1997	CP RAIL	TH 55 EB	16750	14	44	59	4.64	-93	21	20.98		1	7	8	7
27084	44.8896361	-93.3584889	airmap	48	35	55	0	20	0	0	15	1965	TH 62	Wyman Ave	200	19	44	53	22.69	-93	21	30.56		1	6	7	7
27103	44.9160889	-93.3502361	airmap	48	35	35	20	0	0	0	15	1970	MINNEHAHA CREEK	TH 100	110000	12	44	54	57.92	-93	21	0.85		1	6	6	6
27128	44.8886139	-93.3621611	airmap	48	35	35	20	0	0	0	15	1998	CP RAIL	TH 62	42000	12	44	53	19.01	-93	21	43.78		1	7	7	7
27130	44.97655	-93.5272	airmap	48	35	55	0	20	0	0	15	1972	US 12; WB OFF RAMP	WAYZATA BLVD	4800	16	44	58	35.58	-93	31	37.92		1	6	7	5
27131	44.9780833	-93.5225611	airmap	48	35	55	0	20	0	0	15	1970	US 12	Ferndale Rd	3000	19	44	58	41.10	-93	31	21.22		1	7	6	5
27134	44.9900778	-93.2577833	airmap	48	45	45	20	10	0	0	15	1985	BNSF RR	TH 47	14300	16	44	59	24.28	-93	15	28.02		1	7	7	7
27135	44.9762611	-93.5126194	airmap	48	35	55	0	20	0	0	15	1970	US 12; RIDGEVIEW DRIVE	PED AT RIDGEVIEW	1		44	58	34.54	-93	30	45.43		1	6	6	7
27141	44.8604972	-93.4443889	airmap	48	35	55	0	20	0	0	15	1998	Bus Connection	TH 5 EB off ramp	1	19	44	51	37.79	-93	26	39.80		9	7	7	7
27144	44.8623389	-93.4700917	airmap	24	35	55	0	20	0	0	15	1998	WALLACE RD	TH 5 WB	1750	16	44	51	44.42	-93	28	12.33		1	8	8	8
27164	44.9987306	-93.2473306	airmap	48	45	45	20	10	0	0	15	1987	BNSF RR	TH 65; E BROADWAY	18100	16	44	59	55.43	-93	14	50.39		8	6	6	6
27168	45.02115	-93.3487083	airmap	24	35	55	0	20	0	0	15	2000	TH 100	36th Ave N	1	19	45	01	16.14	-93	20	55.35		1	7	8	7
27170	45.0351389	-93.3442333	airmap	24	35	55	0	20	0	0	15	2001	TH 100; RAMPS	WEST BROADWAY	4425	17	45	02	06.5	-93	20	39.24		1	7	8	7
27193	44.9350806	-93.3900444	airmap	48	35	35	20	0	0	0	15	1981	Minnehaha Creek	TH 7	37500	14	44	56	06.29	-93	23	24.16		1	7	6	7
27194	44.8612139	-93.4738528	airmap	48	25	45	0	0	10	0	15	1998	US 212; WB ON RAMP	TH 5 EB	23500	16	44	51	40.37	-93	28	25.87		7	7	7	7
27202	44.9587028	-93.2453389	airmap	48	35	55	0	20	0	0	15	1998	TH 55; NB OFF RAMP	PEDESTRIAN	1		44	57	31.33	-93	14	43.22		1	7	7	7

27211	44.8927194	-93.1841056	airmap	48	45	65	0	20	0	0	25	1971	TH 5 WB ON RAMP	CHAPEL ROAD	500	19	44	53	33.79	-93	11	02.78		1	5	6	6
27217	45.1225222	-93.3101778	airmap	48	35	55	0	10	10	0	15	1998	TH 610	TH 252 NB ON RAMP	9000	14	45	07	21.08	-93	18	36.64		7	7	7	7
27218	45.1228972	-93.3061806	airmap	24	25	45	0	0	10	0	15	1998	TH 610	TH 252 SB	25500	14	45	07	22.43	-93	18	22.25		7	7	8	8
27219	45.1200472	-93.3080583	airmap	24	25	45	0	0	10	0	15	1998	TH 610 WB ON RAMP	TH 252 SB	25500	14	45	07	12.17	-93	18	29.01		7	7	8	8
27222	45.1256222	-93.3461917	airmap	48	35	55	0	20	0	0	15	1997	TH 610	Regent Avenue	1850	19	45	07	32.24	-93	20	46.29		1	7	7	6
27228	45.1382	-93.4944917	airmap	24	35	55	0	20	0	0	15	2016	I 94	TH 610 EB	1	14	45	08	17.52	-93	29	40.17		1	8	8	8
27235	45.1316417	-93.4424222	airmap	48	35	55	0	20	0	0	15	2005	TH 610	ELM CREEK BLVD	940	19	45	07	53.91	-93	26	32.72		1	6	6	7
27236	45.0033389	-93.2473444	airmap	24	35	55	0	20	0	0	15	2014	TH 65	BNSF RR	1		45	00	12.02	-93	14	50.44		5	8	8	8
27237	44.984	-93.3162694	airmap	48	35	35	20	0	0	0	15	1984	BNSF; CP RAIL	TH 55	25000	14	44	59	02.40	-93	18	58.57		9	6	6	7
27239	45.1295139	-93.2987444	airmap	48	35	35	20	0	0	0	15	1985	Mississippi River	TH 610 WB	43500	12	45	07	46.25	-93	17	55.48		1	6	7	7
27240	45.13015	-93.4325639	airmap	24	35	55	0	20	0	0	15	2010	TH 610	HEMLOCK LANE	1	19	45	07	48.54	-93	25	57.23		1	8	8	7
27244	45.1276694	-93.3000194	airmap	48	35	55	0	20	0	0	15	1985	TH 610	West River Road	2850	17	45	07	39.61	-93	18	0.07		1	6	7	6
27245	45.1377056	-93.4622028	airmap	24	35	35	20	0	0	0	15	2017	FERNBROOK LANE	TH 610 WB	25000	11	45	08	15.74	-93	27	43.93		1	8	8	7
27246	45.1375556	-93.4621278	airmap	24	35	35	20	0	0	0	15	2017	FERNBROOK LANE	TH 610 EB	25000	11	45	08	15.20	-93	27	43.66		1	8	8	7
27247	45.1316417	-93.4424222	airmap	24	35	55	0	20	0	0	15	2011	TH 610	ZACHARY LANE	1	16	45	07	53.91	-93	26	32.72		1	8	8	6
27248	45.1304444	-93.4120722	airmap	24	35	55	0	20	0	0	15	2010	TH 610	REVERE LANE	1	17	45	7	49.60	-93	24	43.46		1	8	8	8
27249	45.1303667	-93.4057833	airmap	24	35	55	0	20	0	0	15	2010	TH 610	PED BRIDGE	1		45	07	49.32	-93	24	20.82		1	8	8	7
27252	45.1292889	-93.2985917	airmap	24	35	35	20	0	0	0	15	1999	Mississippi River	TH 610 EB	43500	12	45	07	45.44	-93	17	54.93		1	7	8	7
27253	44.9016194	-93.5604028	airmap	24	35	55	0	20	0	0	15	2001	RECREATION TR; TROLLEY	TH 7 WB Connection	1	16	44	54	05.83	-93	33	37.45		1	8	8	8
27254	44.9807083	-93.3480694	airmap	48	35	35	20	0	0	0	15	2000	CPR RR; N LILAC DR	TH 100	90000	12	44	58	50.55	-93	20	53.05		1	7	7	7
27255	44.9500611	-93.4006917	airmap	24	35	35	20	0	0	0	15	1999	BNSF RR	US 169 SB	48000	12	44	57	0.22	-93	24	02.49		1	8	8	7
27256	44.9960472	-93.4384778	airmap	24	45	45	20	10	0	0	15	1998	UP RR	TH 55 EB	18500	14	44	59	45.77	-93	26	18.52		1	6	8	7
27258	44.9879833	-93.349425	airmap	24	35	35	20	0	0	0	15	2000	UP RR; KQRS DRIVE	TH 100	80000	12	44	59	16.74	-93	20	57.93		1	7	8	7
27280	45.0423194	-93.3303139	airmap	24	35	55	0	20	0	0	15	2003	TH 100	FRANCE AVENUE	4850	17	45	02	32.35	-93	19	49.13		1	7	8	7
27281	45.0442278	-93.3282917	airmap	48	35	55	0	20	0	0	15	2002	TH 100	CP Railroad	1		45	02	39.22	-93	19	41.85		1	7	6	7
27284	45.0261389	-93.3474806	airmap	24	35	55	0	20	0	0	15	2000	TH 100	PED at 39th Ave	1		45	01	34.10	-93	20	50.93		1	8	8	8
27286	45.0349083	-93.3445972	airmap	24	35	55	0	20	0	0	15	2001	TH 100; RAMPS	BNSF RR	1		45	02	05.67	-93	20	40.55		1	8	8	7
27288	45.0389333	-93.3391333	airmap	24	35	35	20	0	0	0	15	2001	Twin Lake Channel	TH 100	71000	12	45	02	20.16	-93	20	20.88		1	7	8	7
27297	44.9017194	-93.741975	airmap	24	35	55	0	20	0	0	15	2010	TH 7	DAKOTA RL REG TRL	1		44	54	06.19	-93	44	31.11	A	2	8	8	8
27302	45.1995583	-93.5521389	airmap	24	35	35	20	0	0	0	15	2015	DIAMOND LAKE ROAD	I94 OFF RMP	47000	12	45	11	58.41	-93	33	07.70		1	8	8	7
27303	44.9408917	-93.3481444	airmap	24	35	55	0	20	0	0	15	2015	TH 100	CMSTP; P RR	1		44	56	27.21	-93	20	53.32		5	8	8	7
27304	44.9411083	-93.3481222	airmap	24	35	55	0	20	0	0	15	2015	TH 100	CEDAR LAKE TRAIL	1		44	56	27.99	-93	20	53.24		1	8	8	7
27405	44.9089667	-93.2750167	airmap	24	35	35	20	0	0	0	15	2008	MINNEHAHA PKWY AND CREEK	I 35W SB	85500	11	44	54	32.28	-93	16	30.06		1	8	8	7
27406	44.909175	-93.2745972	airmap	24	35	35	20	0	0	0	15	2008	MINNEHAHA PKWY; CREEK	I 35W NB	85500	11	44	54	33.03	-93	16	28.55		1	8	8	7
27513	44.9501389	-93.4004361	airmap	48	35	35	20	0	0	0	15	1963	BNSF RR	US 169 NB	48000	12	44	57	0.50	-93	24	01.57		1	7	6	6
27520	44.8869556	-93.3389194	airmap	48	35	55	0	20	0	0	15	1963	TH 62; W 64TH ST	PEDESTRAIN	1		44	53	13.04	-93	20	20.11		1	7	6	7
27524	44.8984417	-93.2114861	airmap	48	45	65	0	20	0	0	25	1966	TH 62	43rd Ave S	1550	17	44	53	54.39	-93	12	41.35		1	6	6	5
27525	44.8936667	-93.2528306	airmap	48	45	65	0	20	0	0	25	1966	TH 62	BLOOMINGTON AVENUE	3300	17	44	53	37.20	-93	15	10.19		1	6	6	5
27539	44.9918278	-93.4007722	airmap	48	35	35	20	0	0	0	15	1968	UP RR	US 169	86000	12	44	59	30.58	-93	24	02.78		1	6	6	6
27544	45.0489472	-93.4008861	airmap	48	35	55	0	20	0	0	15	1969	US 169, E;W FRONTAGE RD	CP RAIL	1		45	02	56.21	-93	24	03.19		1	6	6	6
27567	44.9135028	-93.4012	airmap	48	35	55	0	20	0	0	15	1976	US 169	7th St S	4950	19	44	54	48.61	-93	24	04.32		1	6	6	6
27572	44.8919556	-93.4339972	airmap	48	45	45	20	10	0	0	15	1986	Nine Mile Creek	TH 62 EB	14750	12	44	53	31.04	-93	26	02.39		8	5	7	7
27573	44.8921889	-93.4340889	airmap	48	45	45	20	10	0	0	15	1986	Nine Mile Creek	TH 62 WB	14750	12	44	53	31.88	-93	26	02.72		8	5	7	7
27582	44.8920583	-93.4328917	airmap	48	35	55	0	20	0	0	15	1986	TH 62	Rowland Rd	1050	19	44	53	31.41	-93	25	58.41		1	7	7	7
27586	44.9231194	-93.4016722	airmap	48	35	35	20	0	0	0	15	1978	EXCELSIOR, 3RD ST; RR	US 169	83000	12	44	55	23.23	-93	24	06.02		1	6	7	6
27604	44.9838361	-93.3809444	airmap	24	35	55	0	20	0	0	15	1978	MN 55	PED (Winnetka Ave)	1		44	59	01.81	-93	22	51.40		1	7	8	7
27615	45.062175	-93.3034528	airmap	48	35	55	0	20	0	0	15	1980	TH 100; SB OFF RAMP	PED AT 59TH AVE N	1		45	03	43.83	-93	18	12.43		1	7	6	6
27624A	44.798625	-93.3987583	airmap	48	35	35	20	0	0	0	15	1993	Minnesota River	US 169 NB	31500	12	44	47	55.05	-93	23	55.53		1	7	7	5
27624B	44.7987944	-93.3991083	airmap	48	35	35	20	0	0	0	15	1993	Minnesota River	US 169 SB	31500	12	44	47	55.66	-93	23	56.79		1	7	7	5
27624C	44.7904861	-93.4043	airmap	48	35	55	0	20	0	0	15	1993	WB County 101	US 169 NB on ramp	2000	12	44	47	25.75	-93	24	15.48		1	7	7	6
27624D	44.8053361	-93.3986444	airmap	48	35	55	0	20	0	0	15	1993	Ramp 108th Street	US 169 SB on ramp	500	12	44	48	19.21	-93	23	55.12		1	7	7	7
27624F	44.7910722	-93.405375	airmap	48	35	55	0	20	0	0	15	1993	SB 169 to EB TH 13	US 169 SB off ramp	1000	12	44	47	27.86	-93	24	19.35		1	7	7	7
27624G	44.7911833	-93.4055472	airmap	48	35	55	0	20	0	0	15	1993	County 101 WB	US 169 SB off ramp	1000	12	44	47	28.26	-93	24	19.97		1	7	7	6
27649	45.0561972	-93.3131639	airmap	48	35	55	0	20	0	0	15	1983	TH 100	Pedestrian Bridge	1		45	03	22.31	-93	18	47.39		1	7	6	6
27685	45.1092417	-93.3012694	airmap	24	35	55	0	20	0	0	15	2003	TH 252	PED AT 85th AVE	1		45	06	33.27	-93	18	04.57		1	7	8	8
27701	44.9759222	-93.2817833	airmap	48	45	65	0	20	0	0	25	1985	I 394	Linden Ave	3000	16	44	58	33.32	-93	16	54.42		1	5	6	6
27702	44.9764222	-93.2812806	airmap	48	35	55	0	20	0	0	15	1985	I 394	12th St N	3100	16	44	58	35.12	-93	16	52.61		1	5	7	7
27703	44.9773556	-93.2809056	airmap	48	35	55	0	20	0	0	15	1985	I 394	11th St N	4500	16	44	58	38.48	-93	16	51.26		1	6	7	7
27704	44.9789222	-93.2800028	airmap	48	45	65	0	20	0	0	25	1988	I 394; RAMPS	GLENDWOOD AVE N	2800	16	44	58	44.12	-93	16	48.01		1	6	6	5
27706	44.9818278	-93.27565	airmap	48	35	55	0	20	0	0	15	1986	I 394; RAMPS	5TH ST N	2900	17	44	58	54.58	-93	16	32.34		1	6	7	7
27708	44.9830278	-93.2733639	airmap	48	35	55	0	20	0	0	15	1990	3rd Street North	I 394 WB On Ramp	2000	11	44	58	58.9	-93	16	24.11		1	6	6	8
27710	44.9713278	-93.3776083	airmap	48	35	55	0	20	0	0	15	1989	I 394	PED @ Pennsylvania	1		44	58	16.78	-93	22	39.39		1	7	6	7
27711	44.9714306	-93.3650806	airmap	48	35	55	0	20	0	0	15	1989	I 394	PED @ Florida Ave	1		44	58	17.15	-93	21	54.29		1	7	6	7
27713A	44.8608028	-93.419875	airmap	48	35	55	0	20	0	0	15	1983	Prairie Center Drive	I 494 WB off ramp	4000	11	44	51	38.89	-93	25	11.55		1	7	7	7
27715	44.9899861	-93.28775	airmap	48	35	55	0	20	0	0	15	1979	I 94; SB OFF RAMP	LYNDALE AVE NB	4500	16	44	59	23.95	-93	17	15.90		1	6	7	7
27720	44.98215	-93.2742417	airmap	48	35	55	0	20	0	0	15	1990	Bus ramp, Wash Ave Ramp	I 394 EB off ramp	3200	11	44	58	55.74	-93	16	27.27		1	6	6	6
27726A	44.9776889	-93.2877278	airmap	48	45	45	20	10	0	0	15	1979	BNSF RR; UP RR	I 94 SB OFF RAMP	10900	11	44	58	39.68	-93	17	15.82		1	6	6	6
27726B	44.9763722	-93.2879194	airmap	48	45	45	20	10	0	0	15	1979	LYNDALE; UP RR	I 94 SB OFF RAMP	10900	11	44	58	34.94	-93	17	16.51		1	6	6	6
27727	44.9794667	-93.2874528	airmap	48	45	45	20	0	0	0	25	1978	GLENWOOD AVE; RRS	I 94	117000	11	44	58	46.08	-93	17	14.83		1	6	6	5
27727A	44.9794222	-93.2868944	airmap	48	55	55	20	10	0	0	25	1978	GLENWOOD AVE; RR	I 94 NB OFF RAMP	10600	11	44	58	45.92	-93	17	12.82		1	6	6	5
27728	44.9794278	-93.2870417	airmap	48	55	55	20	10	0	0	25	1978	GLENWOOD AVE; RR	I 94 NB ON RAMP	7100	11	44	58	45.94	-93	17	13.35		1	5	6	6
27733	44.9833139	-93.2750944	airmap	48	35	55	0	20	0	0	15	1990	City parking lot	US 952A off ramp	1000	16	44	58	59.93	-93	16	30.34		1	7	7	7
27739	44.9717583	-93.4014167	airmap	48	35	55	0	20	0	0	15	1987	S FRONTAGE RD	I 394 EB OFF RAMP	4500	11	44	58	18.33	-93	24	05.1		1	7	7	7
27743A	44.9742889	-93.3908694	airmap	48	35	55	0	20	0	0	15	1987	General Mills Blvd	I 394 N Collector	3500	11	44	58	27.44	-93	23	27.13		1	7	7	7
27743B	44.9739444	-93.3909139	airmap	48	35	55	0	20	0	0	15	1987	General Mills Blvd	I 394 S Collector	3500	11	44	58	26.20	-93	23	27.29		1	7	6	7
27744	44.9720194	-93.38185	airmap	48	35	55	0	20	0	0	15	1988	I 394	Winnetka Ave	4700	16	44	58	19.27	-93	22	54.66		1	7	7	6
27746	44.9704972	-93.3564694	airmap	48	35	55	0	20	0	0	15	1988	I 394; COLLECTOR RDS	CP RAIL	1		44	58	13.79	-93	21	23.29		5	6	6	6
27750A	44.9684417	-93.3410639	airmap	48	35	55	0	20	0	0	15	1989	TH 100 NB	I 394R EB ON RAMP	3800	11	44	58	06.39	-93	20	27.83		1	7	7	7
27751	44.9706222	-93.3429861	airmap	48	35	55	0	20	0	0	15	1989	TH 100 SB	I 394R EB ON RAMP	3800	11	44	58	14.24	-93	20	34.75		1	7	6	7
27753A	44.9707111	-93.337775	airmap	48	35	55	0	20	0	0	15	1989	WB 394; 394R; OFF RAMP	WB 394R TO 100NB	3800	11	44	58	14.56	-93	20	15.99		1	7	6	7
27754	44.9727583	-93.3418667	airmap	48	35	55	0	20	0	0	15	1989	SB TH 100 TO WB I 394	I 394 WB ON RAMP	3000	11	44	58	21.93	-93	20	30.72		1	7	7	5
27754A	44.9730417	-93.3416528	airmap	48	35	55	0	20	0	0	15	1989	SB TH 100 TO 394 HOV EB	I 394R EB ON RAMP	3800	11	44	58	22.95	-93	20	29.95		1	7	7	5
27755	44.9704694	-93.3353278	airmap	48	35	55	0	20	0	0	15	1989	I 394; 394R FRONTAGE RD	PEDESTRIAN	1		44	58	13.69	-93	20	7.18		1	7	6	7
27757	44.9701472	-93.3133083	airmap	48	35	55	0	20	0	0	15	1988	I 394, I394R; FRONTAGE	PED @ CEDAR LK RD	1		44	58	12.53	-93	18	47.91		1	6	6	7
27764	44.8616972	-93.2143778	airmap	48	35	55	0	20	0	0	15	1983	from 34th Avenue to	TH 5 EB on ramp	1500	12	44	51	42.11	-93	12	51.76		1	7	6	7
27770A	44.9696972	-93.3066556	airmap	48	35	35	20	0	0	0	15	1987	over railroad yard	I 394 EB	148000	11	44	58	10.91	-93	18	23.96		1	6	7	7
27770B	44.9695444	-93.3049778	airmap	48	35	35	20	0	0	0	15	1987	BNSF; UP RR	I 394 EB	74000	11	44	58	10.36	-93	18	17.92		1	7	6	6
27770C	44.9697028	-93.3040667	airmap	48	45	45	20	10	0	0	15	1987	BNSF; UP RR	I 394 REVERSIBLE	7600	11	44	58	10.93	-93	18	14.64		1	7	7	6
27770D	44.9697861	-93.303725	airmap	48	35	35	20	0	0	0	15	1987	BNSF RR; UP RR	I 394 WB	74000	11	44	58	11.23	-93	18	13.41		1	7	7	5
27776B	44.9739722	-93.2927694	airmap	48	35	55	0	20	0	0	15	1987	I 394; DOWNTOWN RAMPS	I 394R EB	2175	11	44	58	26.30	-93	17	33.97		1	6	6	7
27776D	44.9724194	-93.2964778	airmap	48	45	65	0	20	0	0	25	1987	Linden Ave/Dunwoody Blvd	I 394R ramp	2000	11	44	58	20.71	-93	17	47.32		1	6	6	5
27776E	44.9750028	-93.2910083	airmap	48	35	55	0	20	0	0	15	1987	WB I 94 (St. Paul)	I 394R WB on ramp	1087	11	44	58	30.01	-93	17	27.63		1	6	6	6
27776F	44.9742972	-93.2890389	airmap	48	35	55	0	20	0	0	15	1987	I-94 WB on ramp	I-394R EB ramp	1087	11	44	58	27.47	-93	17	20.54		1	7	6	7
27776G	44.9749	-93.2909472	airmap	48	35	55	0	20	0	0	15	1987	I 394 WB (downtown)	I 394R WB on ramp	1087	11	44	58	29.64	-93	17	27.41		1	6	6	6
27776H	44.9744333	-93.2909083	airmap	48	35	55	0	20	0	0	15	1987	EB I 394 (downtown)	I 394R EB off ramp	1087	11	44	58	27.96	-93	17	27.27		1	6	6	6
27790	44.9686861	-93.3420028	airmap	48	35	55	0	20	0	0	15	1989	South Frontage Road	TH 100 SB Coll Rd	2000	12	44	58	07.27	-93	20	31.21		1	8	7	7
27801	45.0692833	-93.2815861	airmap	48	35	35	20	0	0	0	15	1988	EB Mississippi River	I 694 EB	77500	11	45	04	09.42	-93	16	53.71		1	7	7	7
27806	45.0583639	-93.2873083	airmap	48	35	55	0	20	0	0	15	1979	I 94	57th Ave	2150	17	45	03	30.11	-93	17	14.31		1	6	7	7
27814	45.0058833	-93.2826306	airmap	48	35	55	0	20	0	0	15	1977	I 94	26th Ave N	3300	19	45	00	21.18	-93	16	57.47		1	7	7	7
27816S	44.986075	-93.2799833	airmap	48	55	55	20	10	0	0	25	1982	I 94 ramp RR, streets	US 952A SB	12000	16	44	59	09.87	-93	16	47.94		1	6	6	5
27819	45.0294	-93.2869417	airmap	48	35	55	0	20	0	0	15	1980	I 94	41st Ave N	3800	19	45	01	45.84	-93	17	12.99		1	7	7	7
27821	45.0321389	-93.2874222	airmap	48	35	55	0	20	0	0	15	1982	I 94	CP RAIL	1		45	01	55.70	-93	17	14.72		5	6	6	6
27831B	44.97105	-93.2966944	airmap	48	50	70	0	10	0	25	15	1967	Dunwoody Blvd	I 394 EB off ramp	10200	11	44	58	15.78	-93	17	48.1		1	6	6	6
27831D	44.9741528	-93.2909083	airmap	48	60	80	0	0	10	25	25	1967	EB; WB I 94	I 394 EB OFF RAMP	23000	11	44	58	26.95	-93	17	27.27		7	6	5	5
27856	44.9670806	-93.2205389	airmap	48	45	65	0	20	0	0	25	1994	I 94; RAMPS	27TH AVE SE	3600	19	44	58	01.49	-93	13	13.94		1	6	6	5
27859	44.9662694	-93.2497639	airmap	48	35	35	20	0	0	0	15	1968	CP RAIL; CITY ST	I 94	132000	11	44	57	58.57	-93	14	59.15		1	7	6	5
27861	44.9666056	-93.2497722	airmap	48	45	45	20	10	0	0	15	1968	CP RAIL; CITY ST	I 94 WB OFF RAMP	11000	11	44	57	59.78	-93	14	59.18		1	7	6	6
27864	45.0715222	-93.3092722	airmap	48	35	55	0	20	0	0	15	1980	I 94; I 694	PED @ SHINGLE CRK	1		45	04	17.48	-93	18	33.38		1	7	7	7
27867	44.9503278	-93.2742833	airmap	48	35	35	20	0	0	0	15	1967	Midtown Greenway Trail	I 35W	191000	11	44	57	01.18	-93	16	27.42		1	7	6	5
27876A	44.9694972	-93.2525167	airmap	24	35	55	0	20	0	0	15	2000	I 35W , COLL RDS; RAMPS	6TH STREET / EB 94	1	11	44	58	10.19	-93	15	09.06		1	7	8	5
27880A	44.9724667	-93.2506472	airmap	48	35	55	0	20	0	0	15	1970	3rd Street WB	NB Coll off ramp	1500	16	44	58	20.88	-93	15	02.33		1	6	6	7
27889	45.0032222	-93.2319222	airmap	48	45	45	20	10	0	0	15	1972	Quarry Center outlet	I 35W SB on ramp	7000	11	45	00	11.6	-93	13	54.92		1	6	7	6
27893	45.0020611	-93.2301028	airmap	48	45	45	20	0	0	0	25	1972	CSAH 88; BNSF RR	I 35W	94000	11	45	00	07.42	-93	13	48.37		1	6	6	5
27903	44.9728806	-93.2524222	airmap	48	35	55	0	20	0	0	15	1970	3rd St to dtwn Mpls	I 35W NB Coll ramp	1600	11	44	58	22.37	-93	15	08.72		1	6	7	7
27905	45.0808111	-93.4467167	airmap	48	35	55	0	20	0	0	15	1965	I 494	Fish Lake Road	4000	19	45	04	50.92	-93	26	48.18		1	7	7	7
27909	45.0714861	-93.3096556	airmap	48	45	45	20	0	0	0	25	1980	Shingle Creek	I 94 EB	65500	11	45	04	17.35	-93	18	34.76		9	6	6	4
27923	45.0760194	-93.3327778	airmap	48	35	35	20	0	0	0	15	1965	Brooklyn Blvd Co. 152	I 94 WB	52500	11	45	04	33.67	-93	19	58.00		1	7	7	7
27924	45.075825	-93.3325889	airmap	48	35	35	20	0	0	0	15	1964	Brooklyn Blvd Co. 152	I 94 EB	52500	11	45	04	32.97	-93	19	57.32		1	7	7	7
27926	45.0715528	-93.3096389	airmap	48	45	45	20	0	0	0	25	1964	Shingle Creek	I 694 EB	61000	11	45	04	17.59	-93	18	34.70		9	6	6	4
27929	45.0695583	-93.2940361	airmap	48	45	65	0	20	0	0	25	1980	I 94, I 694; RAMPS	DUPONT AVE	4300	17	45	04	10.41	-93	17	38.53		1	5	7	5
27942	45.214675	-93.5905	airmap	24	35	35	20	0	0	0	15	1973	Crow River	I 94 EB	38000	01	45	12	52.83	-93	35	25.80		1	7	8	7
27943	45.2146861	-93.5901194	airmap	24	35	35	20	0	0	0	15	1973	Crow River	I 94 WB	38000	01	45	12	52.87	-93	35	24.43		1	7	8	7
27944	45.2107194	-93.5838694	airmap	48	35	55	0	20	0	0	15	1969	I 94	Cty Rd 144	1525	06	45	12	38.59	-93	35	01.93		1	6	6	7
27948	45.17175	-93.5268472	airmap	48	35	55	0	20	0	0	15	1969	I 94	BNSF RR	1		45	10	18.30	-93	31	36.65		5	6	6	7
27955	44.9687222	-93.2227528	airmap	48	35	55	0	20	0	0	15	1965	I 94 On/Off Ramps-Huron	PEDESTRIAN	1		44	58	07.4	-93	13	21.91		1	5	7	7
27956	44.9665944	-93.2189722	airmap	48	35	55	0	20	0	0	15	1966	I 94	CP RAIL	1		44	57	59.74	-93	13	08.30		5	6	6	6
27958	44.9623806	-93.2131194	airmap	48	35	55	0	20	0	0	15	1967	I 94	PED @ Seymour	1		44	57	44.57	-93	12	47.23		1	6	6	6

27967	45.10825	-93.4665917	airmap	48	35	35	20	0	0	0	15	1969	Rice Lake Channel	I 94 WB	56000	11	45	06	29.70	-93	27	59.73		1	7	6	7
27968	45.1081556	-93.4667583	airmap	48	35	35	20	0	0	0	15	1969	Rice Lake Channel	I 94 EB	56000	11	45	06	29.36	-93	28	0.33		1	7	6	7
27969	45.1160444	-93.4774861	airmap	48	35	35	20	0	0	0	15	1969	Elm Creek	I 94 WB	56000	11	45	06	57.76	-93	28	38.95		1	7	6	7
27970	45.1159167	-93.4777611	airmap	48	35	35	20	0	0	0	15	1969	Elm Creek	I 94 EB	56000	11	45	06	57.30	-93	28	39.94		1	7	6	7
27985	44.996825	-93.2382389	airmap	48	35	55	0	20	0	0	15	1973	I 35W; NB OFF RAMP	PED @ SUMMER ST	1		44	59	48.57	-93	14	17.66		1	6	7	7
27987	44.9841667	-93.2419611	airmap	48	35	55	0	20	0	0	15	1971	I 35W; OFF-ON RAMPS	PED @ 5TH ST SE	1		44	59	03	-93	14	31.06		8	6	6	7
27990	44.9879111	-93.2371306	airmap	48	35	55	0	20	0	0	15	1969	I 35W, RAMP; FRONT RDS	BNSF RR	1		44	59	16.48	-93	14	13.67		1	7	6	7
27998	44.9672083	-93.2212361	airmap	48	35	55	0	20	0	0	15	1994	I 94; WB OFF RAMP	I 94 EB OFF RAMP	4000	11	44	58	01.95	-93	13	16.45		1	7	6	7
27999	44.9980139	-93.2377722	airmap	48	35	55	0	20	0	0	15	1973	I 35W; NB OFF RAMP	BNSF RR	1		44	59	52.85	-93	14	15.98		1	7	6	6
27A15	44.8456306	-93.3984306	airmap	48	35	35	20	0	0	0	15	1995	South Anderson Lakes	US 169 NB	40000	14	44	50	44.27	-93	23	54.35		1	7	7	7
27A16	44.8458111	-93.3987278	airmap	48	35	35	20	0	0	0	15	1995	South Anderson Lakes	US 169 SB	40000	14	44	50	44.92	-93	23	55.42		1	7	7	7
27A17	44.8525389	-93.3961417	airmap	48	35	35	20	0	0	0	15	1995	North Anderson Lakes	US 169 NB	40000	14	44	51	09.14	-93	23	46.11		1	7	7	7
27A18	44.8527333	-93.3963167	airmap	48	35	35	20	0	0	0	15	1995	North Anderson Lakes	US 169 SB	40000	14	44	51	09.84	-93	23	46.74		1	7	7	7
27A25	45.0808306	-93.4467306	airmap	48	35	55	0	20	0	0	15	1994	I 494	FISH LAKE RD PED	1		45	04	50.99	-93	26	48.23		1	7	6	7
27A71	45.008675	-93.3492972	airmap	48	35	55	0	20	0	0	15	2003	TH 100; E FRT RD	PED (BASSETT CRK)	1		45	00	31.23	-93	20	57.47		1	7	7	8
27A75	45.1629139	-93.3915028	airmap	48	35	55	0	20	0	0	15	2004	US 169	PED	1		45	09	46.49	-93	23	29.41		1	7	7	5
27B42	45.0218861	-93.4007806	airmap	24	35	55	0	20	0	0	15	2008	US 169	PED-BIKE	1		45	01	18.79	-93	24	02.81		1	8	8	7
27R05	44.8589833	-93.2981333	airmap	24	35	55	0	20	0	0	15	2004	I 35W, HUMBOLT; BLOOM	79TH 80TH ST	1600	17	44	51	32.34	-93	17	53.28		1	7	8	7
27R06	45.0377389	-93.3404611	airmap	48	35	55	0	20	0	0	15	2001	FROM CSAH 81	TH 100 NB ON RAMP	1000	19	45	02	15.86	-93	20	25.66		1	8	7	7
27R07	44.9010194	-93.7341833	airmap	24	45	45	20	10	0	0	15	2002	Six Mile Creek	TH 7	15400	14	44	54	03.67	-93	44	03.06		1	7	8	7
27R08	45.0414472	-93.3312222	airmap	48	35	55	0	20	0	0	15	2003	DNR WETLAND FRANCE AVE	NB TH 100 OFF RMP	1000	12	45	02	29.21	-93	19	52.4		1	8	7	7
27R10	45.1338278	-93.4478389	airmap	24	35	35	20	0	0	0	15	2017	ELM CREEK	TH 610 EB	25000	11	45	8	1.78	-93	26	52.22		1	8	8	8
27R17	45.1354917	-93.4487972	airmap	24	35	55	0	20	0	0	15	2005	WET LANDS	PEDESTRAIN TH 610	1		45	08	07.77	-93	26	55.67		1	7	8	8
27R18	45.1060139	-93.3935083	airmap	24	35	35	20	0	0	0	15	2008	CSAH 81, RAMP; BNSF RR	US 169 SB	58000	12	45	06	21.65	-93	23	36.63		1	8	8	8
27R22	45.1090361	-93.3935694	airmap	24	35	55	0	20	0	0	15	2008	CSAH 109; CSAH 81	RAMP(169 SB TO 81)	1	12	45	06	32.53	-93	23	36.85		1	7	8	8
27R29	44.8593	-93.3986444	airmap	48	35	55	0	20	0	0	15	2011	I 494; RAMPS	WASHINGTON AVE	1	17	44	51	33.48	-93	23	55.12		1	8	7	7
27R30	44.8500444	-93.4939222	airmap	24	35	55	0	20	0	0	15	2006	US 212	PED/BIKE	1		44	51	0.16	-93	29	38.12		5	8	8	7
27R31	44.8478639	-93.5164639	airmap	24	35	35	20	0	0	0	15	2006	RILEY CREEK	US 212 WB	36500	14	44	50	52.31	-93	30	59.27		1	8	8	8
27R32	44.84765	-93.5163333	airmap	24	35	35	20	0	0	0	15	2006	RILEY CREEK	US 212 EB	36500	14	44	50	51.54	-93	30	58.8		1	8	8	7
27V07	44.9526583	-93.4596333	airmap	24	35	35	20	0	0	0	15	1998	BNSF RR; STONE RD	I 494 SB	45000	11	44	57	09.57	-93	27	34.68		1	7	8	7
27V08	44.9525528	-93.4593722	airmap	24	35	35	20	0	0	0	15	1998	BNSF RR; STONE RD	I 494 NB	45000	11	44	57	09.19	-93	27	33.74		1	7	8	7
27V26	45.0283917	-93.4526667	airmap	24	35	55	0	20	0	0	15	2000	I 494	PEDESTRIAN	1		45	01	42.21	-93	27	09.60		1	6	8	7
27V28	44.9658833	-93.2496806	airmap	24	45	45	20	10	0	0	15	2000	LRT; FRONT ROAD	I 94 EB ON Ramp	13000	11	44	57	57.18	-93	14	58.85		1	7	8	7
27V34	44.8595778	-93.3626861	airmap	24	35	55	0	20	0	0	15	2003	I 494; ON RAMP	CP RAIL	1		44	51	34.48	-93	21	45.67		5	8	8	7
27V35	44.8601889	-93.3827444	airmap	24	35	55	0	20	0	0	15	2002	I 494	W BUSH LAKE ROAD	3950	17	44	51	36.68	-93	22	57.88		1	7	8	7
27V43	45.0782056	-93.3738333	airmap	24	35	35	20	0	0	0	15	2001	CSAH 81; BNSF RR	I 94 WB	49000	11	45	04	41.54	-93	22	25.80		1	7	8	8
27V44	45.0779944	-93.3737944	airmap	24	35	35	20	0	0	0	15	2001	CSAH 81; BNSF RR	I 94 EB	49000	11	45	04	40.78	-93	22	25.66		1	7	8	7
27V51	44.8987389	-93.4457028	airmap	24	35	35	20	0	0	0	15	2005	CP RAIL	I 494 SB	46000	11	44	53	55.46	-93	26	44.53		1	7	8	7
27V52	44.8988028	-93.4454417	airmap	24	35	35	20	0	0	0	15	2005	CP RAIL	I 494 NB	46000	11	44	53	55.69	-93	26	43.59		1	7	8	7
27V53	44.9023056	-93.4471444	airmap	24	35	35	20	0	0	0	15	2005	HENN CO TRAIL	I 494 SB	92000	11	44	54	08.30	-93	26	49.72		1	7	8	7
27V54	44.9025194	-93.4469611	airmap	24	35	35	20	0	0	0	15	2005	HENN CO TRAIL	I 494 NB	92000	11	44	54	09.07	-93	26	49.06		1	7	8	7
27V57	44.9114278	-93.4492111	airmap	24	35	55	0	20	0	0	15	2005	I 494	PED AT MAYWOOD LN	1		44	54	41.14	-93	26	57.16		5	7	8	8
27V61	44.9346361	-93.4554889	airmap	24	35	55	0	20	0	0	15	2005	I 494	ORCHARD ROAD	870	19	44	56	04.69	-93	27	19.76		1	6	8	6
27V65	44.8889417	-93.2958306	airmap	24	35	55	0	10	10	0	15	2007	I 35W	MN 121 NB	6000	16	44	53	20.19	-93	17	44.99		7	8	8	7
27V67	44.8904722	-93.2957694	airmap	24	35	55	0	20	0	0	15	2007	MN 121	MN 62 WB	1	12	44	53	25.70	-93	17	44.77		1	8	8	7
27V68	44.8897528	-93.2938528	airmap	24	35	55	0	20	0	0	15	2007	I 35W, MN 121, RAMP	MN 62 EB	1	12	44	53	23.11	-93	17	37.87		1	7	8	7
27V69	44.8906222	-93.2957	airmap	24	35	55	0	20	0	0	15	2007	TH 121	RAMP (121N TO 62W)	1	16	44	53	26.24	-93	17	44.52		1	8	8	7
27V70	44.8905639	-93.2883444	airmap	24	35	55	0	20	0	0	15	2007	LYNDALE AVE SO	MN 62 WB	1	12	44	53	26.03	-93	17	18.04		1	8	8	8
27V72	44.8899028	-93.2883222	airmap	24	35	55	0	20	0	0	15	2007	LYNDALE AVE SO	MN 62 EB	1	12	44	53	23.65	-93	17	17.96		1	8	8	7
27V74A	44.8900639	-93.28325	airmap	24	35	35	20	0	0	0	15	2007	CP RAIL	I 35W	156000	11	44	53	24.23	-93	16	59.70		1	8	8	8
27V76	44.8909056	-93.2758278	airmap	24	25	45	0	0	10	0	15	2008	I 35W; NICOLLET AVE S	TH 62 WB	49000	12	44	53	27.26	-93	16	32.98		7	7	8	7
27V78	44.8899917	-93.2781056	airmap	24	35	55	0	20	0	0	15	2007	NICOLLET AVE SO	MN 62 EB	1	12	44	53	23.97	-93	16	41.18		1	7	8	7
27V79	44.8907667	-93.2745583	airmap	24	25	45	0	0	10	0	15	2008	I 35W, MN 62 WB	RAMP (35W TO 62EB)	22750	11	44	53	26.76	-93	16	28.41		7	8	8	7
27V80	44.894275	-93.2753972	airmap	24	35	55	0	20	0	0	15	2008	E 60 ST (MSAS 271)	RAMP (35WSB TO 62)	1	11	44	53	39.39	-93	16	31.43		1	8	8	7
27V95	44.8591583	-93.3938972	airmap	24	35	55	0	20	0	0	15	2011	I 494; US 169; MARTH RD	I 494WB TO US169SB	1	11	44	51	32.97	-93	23	38.03		1	7	8	7
27V96	44.8577833	-93.3951639	airmap	24	35	55	0	20	0	0	15	2012	WASHINGTON AVE	I 494EB TO US169SB	1	11	44	51	28.02	-93	23	42.59		1	8	8	7
27V97	44.8580667	-93.3932333	airmap	24	35	55	0	20	0	0	15	2012	WASHINGTON AVE	US 169 NB TO 494EB	1	11	44	51	29.04	-93	23	35.64		1	7	8	7
27W09	44.9715056	-93.4325333	airmap	24	35	55	0	20	0	0	15	2014	RIDGEDALE DR	I394 WB ON RAMP	1	19	44	58	17.42	-93	25	57.12		1	8	8	7
27W16	45.1365444	-93.4543694	airmap	24	35	55	0	20	0	0	15	2017	CSAH 81 EB	TH 610	1	14	45	08	11.56	-93	27	15.73		1	8	8	8
27W18	44.8594472	-93.3602	airmap	24	35	55	0	20	0	0	15	2017	I 494	E BUSH LAKE RAMP	1	16	44	51	34.01	-93	21	36.72		1	8	8	8
27W19	44.862175	-93.2580028	airmap	24	35	55	0	20	0	0	15	2014	I 494	REGIONAL TRAIL	1		44	51	43.83	-93	15	28.81		2	8	8	8
27W21	45.0437361	-93.4527278	airmap	48	35	35	20	0	0	0	15	2015	SCHMIDT LAKE RD	I 494 SB	39500	11	45	02	37.45	-93	27	09.82		1	8	7	8
27W22	45.0437	-93.4524889	airmap	24	35	35	20	0	0	0	15	2016	Schmidt Lake Rd	I 494 NB	83000	11	45	02	37.32	-93	27	08.96		1	8	8	8
27W23	45.0469083	-93.4524778	airmap	24	35	35	20	0	0	0	15	2015	CP RAIL	I 494 SB	41500	11	45	02	48.87	-93	27	08.92		1	8	8	8
27W24	45.0468583	-93.4522167	airmap	24	35	35	20	0	0	0	15	2016	CP RAIL	I 494 NB	82500	11	45	02	48.69	-93	27	07.98		1	8	8	8
27W27	44.9690139	-93.2533028	airmap	24	35	55	0	20	0	0	15	2015	I35W, RAMPS, 6TH ST	WB I94 / 7TH ST	1	11	44	58	08.45	-93	15	11.89		1	8	8	8
27W30	44.889075	-93.3821194	airmap	24	35	55	0	20	0	0	15	2016	TH 62	NINE MILE CREEK TR	1		44	53	20.67	-93	22	55.63		1	8	8	8
27W31	44.8714611	-93.3503639	airmap	24	35	55	0	20	0	0	15	2016	TH 100	NINE MILE CREEK TR	1		44	52	17.26	-93	21	1.31		1	8	8	8
27W36	45.1819722	-93.3920972	airmap	24	35	35	20	0	0	0	15	2017	Elm Creek	USTH 169 NB	35500	14	45	10	55.10	-93	23	31.55		1	8	8	8
27W37	45.1819694	-93.3924167	airmap	24	35	35	20	0	0	0	15	2017	ELM CREEK	USTH 169 SB	35500	14	45	10	55.09	-93	23	32.70		1	8	8	8
27X02	44.8618639	-93.4742417	airmap	24	35	35	20	0	0	0	15	1998	BIKE TRAIL	TH 5 WB	47000	16	44	51	42.71	-93	28	27.27		13	N	N	N
27X04	44.8590972	-93.3537667	airmap	24	35	35	20	0	0	0	15	2003	N Branch Nine Mile Creek	I 494	139000	11	44	51	32.75	-93	21	13.56		13	N	N	N
27X06	45.0351417	-93.3417889	airmap	24	35	35	20	0	0	0	15	2001	PED	TH 100	71000	16	45	02	06.51	-93	20	30.44		13	N	N	N
27X07	44.8596889	-93.3651056	airmap	24	35	35	20	0	0	0	15	2003	N Branch Nine Mile Creek	I 494	134000	11	44	51	34.88	-93	21	54.38		13	N	N	N
27X10	44.9766417	-93.245925	airmap	24	35	35	20	0	0	0	15	2008	PED TRAIL	I 35W	154000	11	44	58	35.91	-93	14	45.33		13	N	N	N
27X11	44.9399389	-93.2746972	airmap	24	35	55	0	20	0	0	15	2009	STORM SEWER	I 35W MEDIAN	1	11	44	56	23.78	-93	16	28.91		13	N	N	N
27X12	44.93205	-93.2746583	airmap	24	35	55	0	20	0	0	15	2009	STORM SEWER	I 35W MEDIAN	1	11	44	55	55.38	-93	16	28.77		13	N	N	N
27X14	44.8908778	-93.7036889	airmap	24	45	45	20	10	0	0	15	2013	PED TRAIL	TH 7	13200	14	44	53	27.16	-93	42	13.28		13	N	N	N
27X15	44.9046667	-93.4014167	airmap	24	35	35	20	0	0	0	15	2017	NINE MILE CREEK	US TH 169	79000	12	44	54	16.8	-93	24	05.1		13	N	N	N
27X16	44.9046667	-93.4014167	airmap	24	35	35	20	0	0	0	15	2017	NINE MILE CREEK TRAIL	US TH 169	79000	12	44	54	16.8	-93	24	05.1		13	N	N	N
27X17	45.1859944	-93.3925639	airmap	24	35	35	20	0	0	0	15	2018	PED TRAIL	US 169	35500	19	45	11	09.58	-93	23	33.23		13	N	N	N
4765	44.775825	-93.7285222	airmap	24	45	45	20	10	0	0	15	1928	CARVER CREEK	US 212	10000	02	44	46	32.97	-93	43	42.68		13	N	N	N
4933	44.6006194	-92.8125611	airmap	24	45	45	20	10	0	0	15	1930	Cannon River	US 61	7700	06	44	36	02.23	-92	48	45.22		13	N	N	N
5114	44.9323972	-93.4246	airmap	48	45	65	0	20	0	0	25	1934	TH 7	Recreation Trail	1		44	55	56.63	-93	25	28.56		5	6	6	5
5199A	44.9379472	-93.3625556	airmap	48	35	55	0	20	0	0	15	1934	MN 7(FRTG RD)	CP RAIL	1		44	56	16.61	-93	21	45.20		1	7	7	6
5528	44.7790528	-93.3505389	airmap	48	35	55	0	20	0	0	15	1939	MN 13	CP RAIL	1		44	46	44.59	-93	21	01.94		1	6	6	6
5642	45.0086583	-93.3488306	airmap	24	35	35	20	0	0	0	15	1936	Bassett Creek	TH 100	87000	12	45	00	31.17	-93	20	55.79		13	N	N	N
5663	45.5131417	-92.9623806	airmap	24	45	45	20	10	0	0	15	1936	N BR SUNRISE RIVER	TH 95	5045	06	45	30	47.31	-92	57	44.57		13	N	N	N
5829	44.7790361	-93.3431472	airmap	24	35	35	20	0	0	0	15	1939	CREDIT RIVER	TH 13	47000	14	44	46	44.53	-93	20	35.33		13	N	N	N
5830	44.7796667	-93.382225	airmap	24	35	35	20	0	0	0	15	1939	County 101 Eagle Creek	TH 801B EB	25000	14	44	46	46.80	-93	22	56.01		13	N	N	N
5831	44.7780278	-93.3587889	airmap	24	35	35	20	0	0	0	15	1939	STREAM	TH 13 EB	24000	14	44	46	40.90	-93	21	31.64		13	N	N	N
5847	45.041425	-93.5207278	airmap	48	35	55	0	20	0	0	15	1940	MN 55	CP RAIL	1		45	02	29.13	-93	31	14.62		1	6	6	6
5891	44.9842972	-93.3376722	airmap	48	35	35	20	0	0	0	15	1942	CP RAIL	TH 55	23500	14	44	59	03.47	-93	20	15.62		1	6	6	6
5908	44.9840583	-93.3191528	airmap	24	35	35	20	0	0	0	15	1947	Bassett Creek	TH 55	25000	14	44	59	02.61	-93	19	08.95		13	N	N	N
598	45.3894583	-92.8129972	airmap	24	45	45	20	10	0	0	15	1931	STREAM	US 8	14360	02	45	23	22.05	-92	48	46.79		13	N	N	N
6198	45.2086333	-92.9799417	airmap	24	45	45	20	10	0	0	15	1925	HARDWOOD CREEK	US 61	8500	06	45	12	31.08	-92	58	47.79		13	N	N	N
62004	45.0117194	-93.0423889	airmap	24	35	55	0	20	0	0	15	2013	TH 36; RAMPS	BRUCE VENTO TRAIL	1		45	00	42.19	-93	02	32.60		1	8	8	8
62006	45.0096194	-93.0763389	airmap	48	35	55	0	20	0	0	15	1969	TH 36	Edgerton St	1	16	45	00	34.63	-93	04	34.82		1	7	7	5
62007	45.010575	-93.0661556	airmap	48	35	55	0	20	0	0	15	1968	TH 36	Arcade St	1	17	45	00	38.07	-93	03	58.16		1	6	7	6
62009	45.0195111	-92.9848167	airmap	24	35	55	0	20	0	0	15	2010	TH 120	GATEWAY TRAIL	1	16	45	01	10.24	-92	59	05.34	A	2	7	8	7
62012	44.9702333	-93.1670611	airmap	48	45	45	20	0	0	0	25	1965	BNSF Railroad	TH 51 (Snelling)	39500	16	44	58	12.84	-93	10	01.42		1	6	6	5
62016	44.9486278	-93.1665889	airmap	48	35	55	0	20	0	0	15	1989	TH 51; MARSHALL AVENUE	CP RAIL	1		44	56	55.06	-93	09	59.72		5	6	6	6
62016A	44.9486056	-93.16655	airmap	48	35	55	0	20	0	0	15	1989	TH 51; MARSHALL AVENUE	STEAM PIPE	1		44	56	54.98	-93	09	59.58		5	6	6	6
62023	44.9298639	-93.0710972	airmap	48	35	55	0	20	0	0	15	1969	Lafayette Rd (US 52)	PED at Winifred St	1		44	55	47.51	-93	04	15.95		1	7	7	7
62028	44.9554556	-93.079125	airmap	48	35	35	20	0	0	0	15	1978	KITTSON ST;BNSF;CP RAIL	TH 5 EAST 7TH ST	24300	16	44	57	19.64	-93	04	44.85		1	6	7	6
62037	45.0114778	-93.0628139	airmap	24	35	35	20	0	0	0	15	2013	KELLER LAKE	TH 36	69000	12	45	00	41.32	-93	03	46.13		26	8	8	8
62044	44.9222861	-93.0665583	airmap	48	35	55	0	20	0	0	15	1973	US 52 (Lafayette)	Belvidere Street	345	16	44	55	20.23	-93	03	59.61		1	6	6	6
62049	44.9917222	-93.2052083	airmap	24	35	35	20	0	0	0	15	2009	MN COMMERCIAL RR	LARPENTEUR AVE	30976	16	44	59	30.20	-93	12	18.75		1	8	8	8
62050	44.9362028	-93.081025	airmap	48	35	35	20	0	0	0	15	1977	UP RR	US 952A	21000	16	44	56	10.33	-93	04	51.69		1	6	7	5
62062	44.9653944	-93.0660472	airmap	24	45	45	20	10	0	0	15	2001	PHALEN BLVD; UP RR	US 61 (ARCADE ST)	14800	16	44	57	55.42	-93	03	57.77		1	7	8	7
62066	44.9325222	-93.1197361	airmap	48	35	35	20	0	0	0	15	1970	CP RAIL; GRACE ST	TH 5 WEST 7TH ST	27000	16	44	55	57.08	-93	07	11.05		1	7	6	6
62069	45.0101611	-93.1360806	airmap	48	45	65	0	20	0	0	25	1971	TH 36	Victoria CSAH 52	4200	16	45	00	36.58	-93	08	09.89		1	6	6	5
62080A	44.9539639	-93.0724861	airmap	48	60	80	0	10	0	25	25	1982	I 94	Kellogg Blvd	10300	16	44	57	14.27	-93	04	20.95		1	6	6	3
62092	45.0566778	-93.0309306	airmap	24	35	35	20	0	0	0	15	2010	BNSF RR	US 61	22500	16	45	03	24.04	-93	01	51.35		1	7	8	7
62096	45.0134722	-92.9964306	airmap	24	35	55	0	20	0	0	15	2007	MN 36	PEDESTRIAN	1		45	00	48.50	-92	59	47.15		1	8	8	8
62097	45.0155639	-92.9922722	airmap	24	35	55	0	20	0	0	15	2007	MN 36	MARGARET ST	1	17	45	00	56.03	-92	59	32.18		1	8	8	8
62582	45.0506333	-93.1155694	airmap	48	35	55	0	20	0	0	15	1996	I 694; CR 99	PED WALKWAY	1		45	03	02.28	-93	06	56.05		1	7	7	7
62608	44.966625	-93.0879278	airmap	24	45	45	20	10	0	0	15	2013	BNSF RR	CAYUGA STREET	5150	17	44	57	59.85	-93	05	16.54		1	8	8	7
62609	44.9664417	-93.0864028	airmap	24	35	55	0	20	0	0	15	2013	UNIVAR DRIVEWAY	CAYUGA ST	1500	17	44	57	59.19	-93	05	11.05		1	8	8	7
62632	45.0076222	-93.1077806	airmap	24	35	55	0	20	0	0	15	2011	TH 36	EB TH 36 OFF RAMP	1	12	45	00	27.44	-93	06	28.01		1	8	8	7
6266	45.0732194	-92.8074639	airmap	48	35	55	0	20	0	0	15	1912	MN 95	BROWNS CREEK TRAIL	1		45	04	23.59	-92	48	26.87		5	6	6	6
62702	44.953275	-93.088875	airmap	48	35	55	0	20	0	0	15	1990	I 94; RAMPS	E 9TH ST	2750	17	44	57	11.79	-93	05	19.95		1	7	6	5
62723	45.05695	-93.1344444	airmap	24	35	35	20	0	0	0	15	2012	ISLAND LAKE CHANNEL	I 694 WB	48000	11	45	03	25.02	-93	08	04.00		9	8	8	8
62724	45.0568194	-93.1344694	airmap	24	35	35	20	0	0	0	15	2012	ISLAND LAKE CHANNEL	I 694 EB	96000	11	45	03	24.55	-93	08	04.09		9	8	8	8
62729	45.0567361	-93.0574722	airmap	24	35	35	20	0	0	0	15	2015	GOOSE LAKE RD; BNSF RR	I 35E SB	33500	11	45	03	24.25	-93	03	26.90		1	7	8	8
62730	45.0570083	-93.0571722	airmap	24	35	35	20	0	0	0	15	2015	GOOSE LAKE RD; BNSF RR	I 35E NB	67000	11	45	03	25.23	-93	03	25.82		1	7	8	7
62800	44.9517472	-93.1313028	airmap	24	35	55	0	20	0	0	15	2016	I 94	PED AT GROTTO	1		44	57	06.29	-93	07	52.69		1	8	8	8

62802	44.9401111	-93.1152861	airmap	48	35	55	0	20	0	0	15	1985	I 35E; SB ON RAMP	GRAND AVE EB	632	19	44	56	24.4	-93	06	55.03	1	5	6	7
62804	44.9442056	-93.1078028	airmap	48	35	55	0	20	0	0	15	1987	I 35E; THOMPSON ST	PED AT WALNUT ST	1		44	56	39.14	-93	06	28.09	1	6	6	6
62809	44.9517833	-93.1516278	airmap	24	35	55	0	20	0	0	15	2009	I 94; RAMP 16A	GRIGGS ST PED	1		44	57	06.42	-93	09	05.86	1	8	8	7
62814	44.9591833	-93.1993722	airmap	48	35	55	0	20	0	0	15	1965	I 94; EB ON RAMP	CP RAIL	1		44	57	33.06	-93	11	57.74	5	7	6	5
62821	45.0102194	-93.2024917	airmap	48	35	55	0	20	0	0	15	1970	TH 280 SB	TH 280 NB off ramp	2325	16	45	00	36.79	-93	12	08.97	1	6	6	6
62822	45.0374139	-93.0361639	airmap	48	35	55	0	20	0	0	15	1966	I 694	RECREATION TRAIL	1		45	02	14.69	-93	02	10.19	5	6	6	6
62835	45.1046417	-93.050025	airmap	48	35	55	0	20	0	0	15	1967	I 35E	Co Rd H2(CSAH 5)	4550	16	45	06	16.71	-93	03	0.09	1	6	7	6
62842	44.9609667	-93.2021472	airmap	48	35	55	0	20	0	0	15	1966	TH 280; RAMPS	MC RAIL	1		44	57	39.48	-93	12	07.73	5	6	6	7
62843	44.9610472	-93.2020722	airmap	48	45	65	0	20	0	0	25	1966	TH 280; RAMPS	WABASH AVE	3200	19	44	57	39.77	-93	12	07.46	1	5	6	5
62845	44.9528056	-93.1824944	airmap	48	35	55	0	20	0	0	15	1966	I 94	PRIOR AVE	3700	17	44	57	10.10	-93	10	56.98	1	7	6	6
62846	44.95195	-93.1765833	airmap	48	45	65	0	20	0	0	25	1967	I 94	CP RAIL	1		44	57	07.02	-93	10	35.70	5	6	6	5
62848	44.9519389	-93.1765833	airmap	48	45	65	0	20	0	0	25	1966	I 94	Utilities	1		44	57	06.98	-93	10	35.70	1	5	6	6
62849	44.9518306	-93.1715556	airmap	48	45	65	0	20	0	0	25	1966	I 94	PED at ALDINE	1		44	57	06.59	-93	10	17.60	1	5	6	5
62856	44.9682528	-93.09005	airmap	24	35	55	0	20	0	0	15	2015	MET COUNCIL EASEMENT	NW LOOP I 35E SB	1	11	44	58	5.71	-93	5	24.18	1	7	8	6
62861	44.9517639	-93.0557333	airmap	48	35	55	0	20	0	0	15	1973	I 94	Earl Street	2200	17	44	57	06.35	-93	03	20.64	1	6	6	7
62863	44.9295833	-93.1438222	airmap	48	35	55	0	20	0	0	15	1971	Ayd Mill Rd	I 35E SB off ramp	4000	11	44	55	46.50	-93	08	37.76	1	7	7	7
62867	44.9516944	-93.1416167	airmap	24	35	55	0	20	0	0	15	2010	I 94	PED at CHATSWORTH	1		44	57	06.10	-93	08	29.82	1	8	8	7
62868	44.9519056	-93.0625833	airmap	48	35	55	0	20	0	0	15	1973	I 94, HUDSON; PACIFIC	PED AT MAPLE	1		44	57	06.86	-93	03	45.30	1	6	6	6
62872	44.9218417	-93.1448444	airmap	48	35	55	0	20	0	0	15	1984	I 35E	PED at Bayard Ave	1		44	55	18.63	-93	08	41.44	1	7	7	7
62875A	44.9547	-93.0782	airmap	48	45	45	20	10	0	0	15	1989	BNSF RR; 5TH;6TH CONN	I 94 WB OFF RAMP	5750	11	44	57	16.92	-93	04	41.52	1	7	6	7
62885	44.9484111	-93.1052472	airmap	48	35	55	0	20	0	0	15	1988	I 94 connection	Mulberry St	50	19	44	56	54.28	-93	06	18.89	1	7	7	7
62889	44.9514111	-93.0983722	airmap	48	35	55	0	20	0	0	15	1991	I 35E; NB OFF RAMP	CEDAR ST	4900	17	44	57	05.08	-93	05	54.14	1	7	6	6
62890	45.0646861	-93.1863472	airmap	24	35	55	0	20	0	0	15	2015	I 35W; I 35W SB ON RAMP	CSAH 12	1	17	45	03	52.87	-93	11	10.85	1	8	8	8
62892	44.9517361	-93.1207056	airmap	24	35	55	0	20	0	0	15	2016	I 94	PED at Mackubin St	1		44	57	06.25	-93	07	14.54	1	8	8	8
62898	44.94885	-93.1023417	airmap	48	35	55	0	20	0	0	15	1988	I 35E; NB OFF RAMP	10TH STREET	4000	16	44	56	55.86	-93	06	08.43	1	7	6	7
62901	44.8909889	-93.0078389	airmap	48	45	45	20	10	0	0	15	2002	BNSF; CP RR	BAILEY/MAXWELL CON	10000	09	44	53	27.56	-93	00	28.22	1	7	7	5
62902	45.0347833	-93.0892194	airmap	24	35	35	20	0	0	0	15	2006	I 35E , I 694; BNSF RR	I 35 E NB OFF RAMP	23000	11	45	02	05.22	-93	05	21.19	1	7	8	6
62904	45.0370722	-93.0909139	airmap	24	35	35	20	0	0	0	15	2006	BNSF RR	I 694 WB	47000	11	45	02	13.46	-93	05	27.29	1	7	8	8
62909	45.0376167	-93.0578389	airmap	24	35	55	0	20	0	0	15	2006	I 694; RAMPS	LABORE ROAD	2200	16	45	02	15.42	-93	03	28.22	1	8	8	6
62912	44.9044639	-93.1391361	airmap	24	35	35	20	0	0	0	15	2001	MISSISSIPPI ; UP RR	I 35E	87000	11	44	54	16.07	-93	08	20.89	1	7	8	7
62914	45.0369806	-93.0914972	airmap	48	35	35	20	0	0	0	15	2006	BNSF RR	I 694 EB	47000	11	45	02	13.13	-93	05	29.39	1	8	7	8
62920	44.9633361	-93.0902167	airmap	48	35	35	20	0	0	0	15	2014	BNSF RR; MINNEHAHA AV	I35E NB	69500	11	44	57	48.01	-93	05	24.78	1	7	7	8
62921	44.9635083	-93.0909194	airmap	24	35	35	20	0	0	0	15	2014	BNSF RR; MINNEHAHA AV	I 35E SB	69000	11	44	57	48.63	-93	05	27.31	1	8	8	8
62924	44.966725	-93.0890806	airmap	24	35	35	20	0	0	0	15	2014	CAYUGA ST; BNSF RR	I 35E NB	69000	11	44	58	0.21	-93	05	20.69	1	7	8	7
62925	44.9667556	-93.0905083	airmap	24	35	35	20	0	0	0	15	2015	BNSF RR; CAYUGA ST	I 35E SB	69000	11	44	58	0.32	-93	05	25.83	1	8	8	8
62J12	45.0155556	-92.9922722	airmap	24	45	45	20	10	0	0	15	2008	GATEWAY TRAIL	MARGARET ST	5806	19	45	00	56	-92	59	32.18	13	N	N	N
62X02	44.9088694	-93.142975	airmap	24	35	35	20	0	0	0	15	2001	Ped Trail	I 35E	77000	11	44	54	31.93	-93	08	34.71	13	N	N	N
62X03	44.9768333	-93.0920639	airmap	24	45	45	20	10	0	0	15	2012	GATEWAY TRAIL	MARYLAND AVE	19900	16	44	58	36.60	-93	5	31.43	13	N	N	N
6566	45.4019056	-92.6504222	airmap	48	45	45	20	10	0	0	15	1955	ST CROIX RIVER	US 8 Taylors Falls	9993	02	45	24	06.86	-92	39	01.52	1	7	6	6
6582	45.0502278	-93.11505	airmap	48	35	55	0	20	0	0	15	1958	I 694; CO RD E	CP RAIL	1		45	03	0.82	-93	06	54.18	6	7	6	6
6652	44.8291694	-93.2924194	airmap	48	35	55	0	20	0	0	15	1957	I 35 W	CP Rail	1		44	49	45.01	-93	17	32.71	5	8	6	6
6692	44.9962222	-93.0659861	airmap	48	55	55	20	10	0	0	25	1951	PED-BIKE TRAIL	US 61	15100	16	44	59	46.40	-93	03	57.55	9	6	6	5
6721	44.9959778	-93.4379861	airmap	48	45	45	20	10	0	0	15	1952	UP RR	TH 55 WB	17000	14	44	59	45.52	-93	26	16.75	1	7	6	7
6732	44.9847361	-93.3880083	airmap	24	35	35	20	0	0	0	15	1951	BASSETT CREEK	TH 55 EB-WB	35000	14	44	59	05.05	-93	23	16.83	13	N	N	N
6752	45.3785667	-93.2361361	airmap	24	35	35	20	0	0	0	15	1951	Cedar Creek	TH 65	21500	14	45	22	42.84	-93	14	10.09	13	N	N	N
6802	44.6721611	-93.6350778	airmap	48	35	35	20	0	0	0	15	1954	SAND CREEK	US 169	22400	02	44	40	19.78	-93	38	06.28	1	7	7	7
6803	44.6737556	-93.6275556	airmap	48	35	35	20	0	0	0	15	1955	UP RR	US 169	23500	02	44	40	25.52	-93	37	39.20	1	7	7	7
6817	45.2327528	-93.234925	airmap	48	45	45	20	10	0	0	15	1953	COON CREEK	TH 65 SB	16250	14	45	13	57.91	-93	14	05.73	8	6	6	7
6859	44.6687083	-93.6346139	airmap	48	45	45	20	10	0	0	15	1955	SAND CREEK	TH 282	8000	06	44	40	07.35	-93	38	04.61	1	6	6	7
6894	44.9771472	-93.2026889	airmap	48	35	35	20	0	0	0	15	1959	BNSF RR; ENERGY PK Dr	TH 280	47000	12	44	58	37.73	-93	12	09.68	1	7	6	6
6988	45.0425667	-93.5223611	airmap	24	35	35	20	0	0	0	15	1940	Elm Creek	TH 55	30500	14	45	2	33.24	-93	31	20.5	13	N	N	N
6989	44.6014667	-93.7907111	airmap	24	45	45	20	10	0	0	15	1955	ROBERT CREEK	US 169	16600	02	44	36	05.28	-93	47	26.56	13	N	N	N
6990	44.6893722	-93.6078722	airmap	24	35	35	20	0	0	0	15	1900	DITCH	US 169	31000	02	44	41	21.74	-93	36	28.34	13	N	N	N
70006	44.785725	-93.4017639	airmap	48	35	35	20	0	0	0	15	1991	UP RR	TH 901B EB	25000	14	44	47	08.61	-93	24	06.35	1	6	7	7
70008	44.7842	-93.4087528	airmap	48	35	55	0	20	0	0	15	1994	TH 169R	Stagecoach Rd	910	14	44	47	03.12	-93	24	31.51	1	7	7	7
70011	44.7761639	-93.5407028	airmap	48	35	55	0	20	0	0	15	1995	US 169	CSAH 15	3050	16	44	46	34.19	-93	32	26.53	1	7	7	6
70012	44.7761639	-93.5305861	airmap	48	35	55	0	20	0	0	15	1995	US 169	MSAS 117	1050	17	44	46	34.19	-93	31	50.11	1	7	7	6
70027	44.6301778	-93.7646111	airmap	48	45	45	20	10	0	0	15	1987	UP RR	TH 25	5800	06	44	37	48.64	-93	45	52.60	1	7	7	7
70041	44.774475	-93.5894694	airmap	48	45	45	20	10	0	0	15	1998	Minnesota River Overflow	TH 41	12500	14	44	46	28.11	-93	35	22.09	1	7	7	7
70523	44.7870861	-93.4101417	airmap	48	45	45	20	10	0	0	15	1994	UP RR; CSAH 18	US 169 NB	17750	14	44	47	13.51	-93	24	36.51	1	7	7	6
70524	44.7874917	-93.4102028	airmap	48	45	45	20	10	0	0	15	1994	UP RR; CSAH 18	US 169 SB	17750	14	44	47	14.97	-93	24	36.73	1	7	7	7
70536	44.7780528	-93.5051194	airmap	24	35	55	0	20	0	0	15	2002	US 169	PED E OF CSAH 17	1		44	46	40.99	-93	30	18.43	1	8	8	7
70539	44.7763111	-93.5203694	airmap	24	35	55	0	20	0	0	15	2002	US 169	PED W OF CR 79	1		44	46	34.72	-93	31	13.33	1	8	8	8
70550	44.7761528	-93.5304639	airmap	24	35	55	0	20	0	0	15	2010	US 169	PED TRAIL	1	09	44	46	34.15	-93	31	49.67	1	8	8	8
70802	44.5945861	-93.2982639	airmap	48	45	65	0	20	0	0	25	1964	I 35	CR 62	1300	08	44	35	40.51	-93	17	53.75	1	6	6	5
70805	44.6235722	-93.2982333	airmap	48	35	55	0	20	0	0	15	1964	I 35	225 ST	1850	08	44	37	24.86	-93	17	53.64	1	7	7	5
70X01	44.55685	-93.5843194	airmap	24	45	45	20	10	0	0	15	1999	Phillips Creek	TH 21	5700	06	44	33	24.66	-93	35	3.55	14	N	N	N
72012	44.6332389	-93.7657694	airmap	24	45	45	20	10	0	0	15	2005	Minnesota River	TH 25	5800	07	44	37	59.66	-93	45	56.77	1	6	7	7
82009	45.0359111	-92.9456028	airmap	48	35	35	20	0	0	0	15	1987	DNR Gateway Trail	TH 36	37000	14	45	02	09.28	-92	56	44.17	8	7	7	7
82010	44.7489	-92.8045722	airmap	48	45	45	20	10	0	0	15	1990	St Croix River	US 10 (PRESCOTT)	15700	06	44	44	56.04	-92	48	16.46	18	6	7	7
82012	45.0848861	-92.786375	airmap	48	35	55	0	20	0	0	15	1968	GORGE	PED	1		45	05	05.59	-92	47	10.95	1	7	6	7
82013	45.1232694	-92.7666778	airmap	48	35	55	0	20	0	0	15	1991	TH 95	WC LIMITED RR	1		45	07	23.77	-92	46	0.04	5	7	7	7
82016	44.9257389	-92.9687944	airmap	48	35	55	0	20	0	0	15	2006	I 494	VALLEY CREEK RD	1800	16	44	55	32.66	-92	58	07.66	1	7	7	7
82018	45.2238833	-92.7635944	airmap	24	35	55	0	20	0	0	15	1975	OBRIEN TR N	TH 95	4400	06	45	13	25.98	-92	45	48.94	1	6	8	7
82022	44.7564556	-92.8533389	airmap	48	35	35	20	0	0	0	15	1978	BNSF RR	US 61	30000	14	44	45	23.24	-92	51	12.02	1	7	6	6
82023	45.0356639	-92.9505694	airmap	24	35	35	20	0	0	0	15	2013	HIILTON TRAIL	TH 36 WB	22500	14	45	02	08.39	-92	57	02.05	1	8	8	8
82026	44.8502056	-92.9906528	airmap	24	45	45	20	10	0	0	15	2005	CP RR	CSAH 22(US61 FRONT	10700	16	44	51	0.74	-92	59	26.35	1	8	8	8
82028	44.8666889	-92.9991528	airmap	48	35	55	0	20	0	0	15	2003	US 61, HASTING AVE, 7TH	PED	1		44	52	0.08	-92	59	56.95	1	7	7	7
82031	44.8713778	-93.0011611	airmap	24	45	45	20	10	0	0	15	2003	7TH AVE; BNSF; CP RR	GLEN ROAD	5000	19	44	52	16.96	-93	0	4.18	1	7	8	7
82034A	44.8865083	-93.0060806	airmap	24	45	45	20	10	0	0	15	2003	BNSF RR; CP RR	I 494 WB ON RAMP	10000	11	44	53	11.43	-93	00	21.89	1	6	8	7
82037	44.8836361	-93.0051889	airmap	24	45	45	20	10	0	0	15	2003	BN; CP RAILROADS	RAMP 494E TO TH61S	9000	11	44	53	01.09	-93	00	18.68	1	6	8	7
82049	44.7536278	-92.8531278	airmap	24	35	35	20	0	0	0	15	2013	CP RR	US 61	29500	14	44	45	13.06	-92	51	11.26	1	8	8	8
82050	45.2593806	-92.9835361	airmap	24	35	55	0	20	0	0	15	2016	TH 97	PEDESTRIAN	1		45	15	33.77	-92	59	0.73	2	8	8	8
82515	45.2548611	-92.9856417	airmap	24	35	55	0	20	0	0	15	1999	TH 97	PEDESTRIAN	1		45	15	17.50	-92	59	08.31	1	8	8	7
82516	44.9873972	-92.9605639	airmap	24	35	55	0	20	0	0	15	1999	I 694	PEDESTRIAN	1		44	59	14.63	-92	57	38.03	1	7	8	8
82522	45.0798639	-92.8966972	airmap	24	35	55	0	20	0	0	15	2004	TH 96	GATEWAY TRAIL	1		45	04	47.51	-92	53	48.11	3	7	8	8
82528	45.2686167	-93.0088056	airmap	24	35	55	0	20	0	0	15	2010	I 35	220TH ST N	2800	17	45	16	07.02	-93	00	31.70	1	7	8	7
82800	44.96255	-92.7622083	airmap	48	35	35	20	0	0	0	15	1994	ST CROIX RIVER; ST	I 94 EB	41000	01	44	57	45.18	-92	45	43.95	1	6	7	7
82805	44.9932972	-92.9604944	airmap	48	35	35	20	0	0	0	15	1967	UP RR	I 694 SB	36500	11	44	59	35.87	-92	57	37.78	1	7	7	6
82806	44.9933389	-92.9601139	airmap	48	35	35	20	0	0	0	15	1967	UP RR	I 694 NB	36500	11	44	59	36.02	-92	57	36.41	1	7	7	6
82809	45.0209944	-92.9595778	airmap	48	35	55	0	20	0	0	15	1967	50TH ST N	I 694 SB	3000	11	45	01	15.58	-92	57	34.48	1	6	7	7
82811	45.02645	-92.96025	airmap	48	35	35	20	0	0	0	15	1967	DNR TRAIL	I 694 SB	67000	11	45	01	35.22	-92	57	36.90	1	7	7	7
82812	45.0264667	-92.9598694	airmap	48	35	35	20	0	0	0	15	1967	DNR TRAIL	I 694 NB	67000	11	45	01	35.28	-92	57	35.53	1	7	7	7
82816	45.0065778	-92.9577778	airmap	48	35	55	0	20	0	0	15	1967	I 694	40th Street North	590	17	45	0	23.68	-92	57	28.00	1	7	7	5
82817	44.9531889	-92.9586722	airmap	48	35	55	0	20	0	0	15	1966	I 694	4th Street North	3050	19	44	57	11.48	-92	57	31.22	1	6	6	6
8283	45.2954667	-92.9863444	airmap	24	45	45	20	10	0	0	15	1925	DITCH	US 61	12500	06	45	17	43.68	-92	59	10.84	13	N	N	N
8284	45.3003972	-92.9879917	airmap	24	45	45	20	10	0	0	15	1925	DITCH	US 61	12500	06	45	18	01.43	-92	59	16.77	13	N	N	N
82845	44.9486306	-92.8830944	airmap	48	45	65	0	20	0	0	25	1983	I 94	CSAH 17	1750	08	44	56	55.07	-92	52	59.14	1	6	6	5
82847	44.9486417	-92.8428417	airmap	48	35	55	0	20	0	0	15	1983	I 94	CR 71	1500	07	44	56	55.11	-92	50	34.23	1	6	6	6
82848	44.9548194	-92.7968056	airmap	48	45	65	0	20	0	0	25	1983	I 94	CSAH 21	2950	07	44	57	17.35	-92	47	48.50	1	6	6	5
82859	44.8855778	-93.0043194	airmap	48	35	35	20	0	0	0	15	2003	CP; BNSF RR; TH 61	I 494 EB	43500	11	44	53	08.08	-93	00	15.55	1	6	7	7
82860	44.8858444	-93.0044333	airmap	24	35	35	20	0	0	0	15	2003	TH 61; CP; BNSF RR	I 494 WB	43500	11	44	53	09.04	-93	00	15.96	1	6	8	7
8350	44.67485	-93.6258472	airmap	24	45	45	20	10	0	0	15	1900	STREAM	TH 21	7200	06	44	40	29.46	-93	37	33.05	13	N	N	N
8424	45.07645	-92.8062833	airmap	24	45	45	20	10	0	0	15	1934	BROWNS CREEK	TH 95	6200	16	45	4	35.22	-92	48	22.62	13	N	N	N
8425	45.0792083	-92.8031389	airmap	24	45	45	20	10	0	0	15	1934	SILVER CREEK	TH 95	6200	16	45	04	45.15	-92	48	11.30	13	N	N	N
8454	44.5240389	-93.1402889	airmap	24	45	45	20	10	0	0	15	1921	STREAM	TH 3	5300	06	44	31	26.54	-93	08	25.04	13	N	N	N
8455	44.5275278	-93.1383667	airmap	24	45	45	20	10	0	0	15	1921	DITCH	TH 3	5300	06	44	31	39.10	-93	08	18.12	13	N	N	N
8456	44.5366028	-93.1366806	airmap	24	45	45	20	10	0	0	15	1921	STREAM	TH 3	5300	06	44	32	11.77	-93	08	12.05	13	N	N	N
8457	44.5757722	-93.1368028	airmap	24	45	45	20	10	0	0	15	1921	N BR Chub Creek	TH 3	5500	06	44	34	32.78	-93	08	12.49	13	N	N	N
8458	44.6199611	-93.1368028	airmap	24	45	45	20	10	0	0	15	1921	S BR Vermillion River	TH 3	7400	06	44	37	11.86	-93	08	12.49	13	N	N	N
86005	45.2888528	-93.5583333	airmap	48	35	35	20	0	0	0	15	1993	SB/Mississippi River	TH 101 SB	25350	14	45	17	19.87	-93	33	30.00	1	7	7	7
86005A	45.2896833	-93.5574417	airmap	48	35	55	0	20	0	0	15	1993	TH 10 EB	TH 101 SB on ramp	1000	06	45	17	22.86	-93	33	26.79	1	7	7	7
86006	45.2886556	-93.5581972	airmap	48	35	35	20	0	0	0	15	2001	NB/Mississippi River	TH 101 NB	25350	14	45	17	19.16	-93	33	29.51	1	7	7	7
86014	45.2524111	-93.5552361	airmap	24	35	55	0	20	0	0	15	2006	TH 101	CSAH 37	2200	07	45	15	08.68	-93	33	18.85	1	8	8	8
86019	45.2270056	-93.5530083	airmap	24	45	45	20	10	0	0	15	2006	Crow River	TH 101 SB Ramp	5000	14	45	13	37.22	-93	33	10.83	1	8	8	8
86020	45.2267917	-93.5519861	airmap	24	45	45	20	10	0	0	15	2006	Crow River	TH 101 NB Ramp	5000	14	45	13	36.45	-93	33	7.15	1	8	8	8
8635	45.5111944	-93.01325	airmap	24	45	45	20	10	0	0	15	1947	N BR SUNRISE RIVER	TH 95	8900	06	45	30	40.3	-93	00	47.7	13	N	N	N
8695	44.6544194	-93.1367028	airmap	24	45	45	20	10	0	0	15	1948	STREAM	TH 3	10100	16	44	39	15.91	-93	08	12.13	13	N	N	N
86X06	45.2808806	-93.5603333	airmap	24	35	35	20	0	0	0	15	2006	STREAM	TH 101	50700	14	45	16	51.17	-93	33	37.20	13	N	N	N
86X07	45.2814361	-93.5616444	airmap	24	45	45	20	10	0	0	15	2006	STREAM	CSAH 39(TH101RTWAY	11300	06	45	16	53.17	-93	33	41.92	13	N	N	N
8733	44.8608278	-93.4489833	airmap	24	35	35	20	0	0	0	15	1949	PURGATORY CREEK	US 212	64000	12	44	51	38.98	-93	26	56.34	13	N	N	N
8787	45.0937278	-93.2435306	airmap	24	35	35	20	0	0	0	15	1953	RICE CREEK	TH 65	34000	14	45	5	37.42	-93	14	36.71	13	N	N	N
8829	44.7295389	-93.588075	airmap	24	35	35	20	0	0	0	15	1953	STREAM	US 169	29000	02	44	43	46.34	-93	35	17.07	13	N	N	N
8839	44.6271222	-93.7408611	airmap	24	35	35	20	0	0	0	15	1955	DITCH	US 169	22100	02	44	37	37.64	-93	44	27.10	13	N	N	N
8840	44.669925	-93.6413944	airmap	24	35	35	20	0	0	0	15	1954	STREAM	US 169	22400	02	44	40	11.73	-93	38	29.02	13	N	N	N
8850	44.6746167	-93.6252222	airmap	24	35	35	20	0	0	0	15	1954	DITCH	US 169	23500	02	44	40	28.62	-93	37	30.80	13	N	N	N
8999	45.0759306	-93.2453	airmap	24	35	35	20	0	0	0	15	1954	Moore Lake	TH 65	30000	14	45	04	33.35	-93	14	43.08	15	N	N	N

9036	44.9438889	-93.0874722	airmap	48	65	65	20	10	10	0	25	1926	MISSISSIPPI RIVER; RR	ROBERT ST (US952A)	19000	16	44	56	38.00	-93	05	14.90	W	12	6	5	4
90383	44.9351806	-93.029725	airmap	24	35	35	20	0	0	0	15	1923	STREAM	US 61	39500	14	44	56	6.65	-93	1	47.01		13	N	N	N
90754	45.0526194	-92.9671639	airmap	24	45	45	20	10	0	0	15	1956	STREAM	TH 244	14200	16	45	03	09.43	-92	58	01.79		15	N	N	N
9078	44.8617056	-93.2743917	airmap	48	35	55	0	20	0	0	15	1960	I 494; N; S FRONT RDS	PED AT 2ND AVE S	1		44	51	42.14	-93	16	27.81		1	7	6	7
9081A	44.8622111	-93.2476861	airmap	48	35	55	0	20	0	0	15	1958	I 494	TH 77 SB COLL RD	4000	12	44	51	43.96	-93	14	51.67		1	7	6	6
91018	45.5140417	-92.9929583	airmap	24	35	35	20	0	0	0	15	1967	N BR SUNRISE RIVER	I 35	26875	01	45	30	50.55	-92	59	34.65		15	N	N	N
91019	45.6807333	-92.990425	airmap	24	35	35	20	0	0	0	15	1967	RUSH CREEK	I 35	21151	01	45	40	50.64	-92	59	25.53		13	N	N	N
91020	45.3352139	-93.0047083	airmap	24	35	35	20	0	0	0	15	1967	S BR SUNRISE RIVER	I 35	42205	01	45	20	6.77	-93	0	16.95		13	N	N	N
91021	45.3936222	-92.9940722	airmap	24	35	35	20	0	0	0	15	1967	W BR SUNRISE RIVER	I 35	35898	01	45	23	37.04	-92	59	38.66		13	N	N	N
91035	45.17395	-93.3003611	airmap	24	35	35	20	0	0	0	15	1965	Coon Creek	US 10	86000	12	45	10	26.22	-93	18	01.30		13	N	N	N
91051	44.9408806	-93.4579556	airmap	24	45	45	20	10	0	0	15	1965	MINNEHAHA CREEK	494 SB FR(CSAH 16)	9500	17	44	56	27.17	-93	27	28.64		13	N	N	N
91052	44.9413	-93.4546194	airmap	24	45	45	20	10	0	0	15	1965	Minnehaha Creek	I 494 NBon-off rmp	5200	11	44	56	28.68	-93	27	16.63		13	N	N	N
91070	45.0940083	-93.1921306	airmap	24	35	35	20	0	0	0	15	1963	Rice Creek	US 810A County 10	26500	16	45	05	38.43	-93	11	31.67		13	N	N	N
91071	45.09465	-93.1881944	airmap	24	35	35	20	0	0	0	15	1963	RICE CREEK	I 35W	130000	11	45	05	40.74	-93	11	17.50		13	N	N	N
9109	44.7967111	-93.0378583	airmap	48	35	35	20	0	0	0	15	1958	UP RR	US 52 NB	23000	14	44	47	48.16	-93	2	16.29		1	6	6	6
91097	45.0916472	-93.2635278	airmap	24	35	35	20	0	0	0	15	1965	Rice Creek	TH 47	32000	16	45	05	29.93	-93	15	48.70		13	N	N	N
91105	44.7798528	-93.3829806	airmap	24	35	35	20	0	0	0	15	1965	County 101 Eagle Creek	TH 801B WB	25000	14	44	46	47.47	-93	22	58.73		13	N	N	N
91112	44.9795444	-93.4005806	airmap	24	35	35	20	0	0	0	15	1967	BASSETT CREEK	US 169	96000	12	44	58	46.36	-93	24	02.09		13	N	N	N
91115	44.9438361	-93.4001306	airmap	24	35	35	20	0	0	0	15	1967	MINNEHAHA CREEK	US 169	96000	12	44	56	37.81	-93	24	0.47		13	N	N	N
91178	45.1449139	-93.4989	airmap	24	35	35	20	0	0	0	15	1969	RUSH CREEK	I 94	95000	11	45	08	41.69	-93	29	56.04		13	N	N	N
91181	45.3364306	-93.0026861	airmap	24	45	45	20	10	0	0	15	1967	S BR SUNRISE RIVER	US 61	13680	06	45	20	11.15	-93	00	09.67		13	N	N	N
91183	45.580925	-92.992775	airmap	24	35	35	20	0	0	0	15	1967	GOOSE CREEK	I 35	23383	01	45	34	51.33	-92	59	33.99		13	N	N	N
91184	45.5846444	-92.9931417	airmap	24	35	35	20	0	0	0	15	1967	GOOSE CREEK	I 35	23383	01	45	35	04.72	-92	59	35.31		13	N	N	N
91185	45.6099139	-92.9933083	airmap	24	35	35	20	0	0	0	15	1967	GOOSE CREEK	I 35	23383	01	45	36	35.69	-92	59	35.91		15	N	N	N
91210	45.0165528	-93.4564278	airmap	24	35	35	20	0	0	0	15	1965	STREAM	I 494	85000	11	45	00	59.59	-93	27	23.14		15	N	N	N
91226	44.6223639	-93.5016028	airmap	24	45	45	20	10	0	0	15	1971	Porter Creek	TH 13	5600	06	44	37	20.51	-93	30	05.77		15	N	N	N
91233	44.8642	-93.3505639	airmap	24	45	45	20	10	0	0	15	1972	Nine Mile Creek	TH 100 Side road	13700	16	44	51	51.12	-93	21	02.03		13	N	N	N
91234	44.8652722	-93.3512889	airmap	24	45	45	20	10	0	0	15	1972	Nine Mile Creek	TH 100 SB ramps	6300	12	44	51	54.98	-93	21	4.64		15	N	N	N
9155	44.8929444	-93.1830889	airmap	48	35	55	0	20	0	0	15	1960	TH 5	Aband Tower Ave	1		44	53	34.60	-93	10	59.12		8	6	6	6
9300	44.894325	-93.1814639	airmap	48	35	35	20	0	0	0	15	1961	MISS RIVER; CITY ST	TH 5 (WEST 7 ST)	28500	14	44	53	39.57	-93	10	53.27		6	8	7	7
9318	44.7706806	-93.9540167	airmap	48	45	45	20	10	0	0	15	1959	TCW RR	US 212 WB	6000	02	44	46	14.45	-93	57	14.46		1	7	7	7
9319	44.7706194	-93.9535306	airmap	48	45	45	20	10	0	0	15	1959	TCW RR	US 212 EB	6000	02	44	46	14.23	-93	57	12.71		1	7	7	7
9321	45.0695222	-93.2816472	airmap	48	35	35	20	0	0	0	15	1963	Mississippi River	I 694 WB	77500	11	45	04	10.28	-93	16	53.93		1	7	6	7
93482	44.9867083	-93.2885806	airmap	24	35	35	20	0	0	0	15	1915	Bassett Creek Tunnel	I 94	113000	11	44	59	12.15	-93	17	18.89		13	N	N	N
93483	44.9869	-93.2880861	airmap	24	45	45	20	10	0	0	15	1980	Bassett Creek	I 94 W Frontage Rd	6400	16	44	59	12.84	-93	17	17.11		13	N	N	N
9350	44.9661667	-93.2259361	airmap	48	35	35	20	0	0	0	15	1963	MISS R, ramp, W River Rd	I 94	167000	11	44	57	58.20	-93	13	33.37		1	7	6	7
9351	45.0196306	-93.1891472	airmap	48	35	35	20	0	0	0	15	1963	BNSF RR; W FR RD	I 35W SB	56000	11	45	1	10.67	-93	11	20.93		1	6	6	6
9352	45.0196417	-93.1888056	airmap	48	35	35	20	0	0	0	15	1963	BNSF RR; W FR RD	I 35W NB	56000	11	45	1	10.71	-93	11	19.70		1	6	6	6
9379	44.951625	-93.1619111	airmap	48	45	65	0	20	0	0	25	1964	I 94; EB ENT RAMP	PASCAL ST	3900	19	44	57	05.85	-93	09	42.88		1	6	6	5
9387	44.9517389	-93.1263278	airmap	48	45	65	0	20	0	0	25	1961	I 94	DALE ST(CSAH 53)	1	16	44	57	06.26	-93	07	34.78		1	6	6	5
9390	45.0665778	-93.1952889	airmap	48	35	55	0	20	0	0	15	1964	I 694	MC RAIL	1		45	03	59.68	-93	11	43.04		5	7	6	7
9391	44.9919361	-92.7777556	airmap	48	45	45	20	10	0	0	15	1960	UP RR	TH 95	13000	06	44	59	30.97	-92	46	39.92		1	6	7	5
9425	44.5177944	-92.9229056	airmap	48	45	45	20	10	0	0	15	1964	Cannon River	US 52 NB	9700	02	44	31	4.06	-92	55	22.46		1	7	6	6
9426	44.5176194	-92.9231722	airmap	48	45	45	20	10	0	0	15	1964	Cannon River	US 52 SB	9700	02	44	31	3.43	-92	55	23.42		1	7	7	7
94274	45.0929333	-92.9667361	airmap	48	35	55	0	20	0	0	15	1992	MN 96	PED WALKWAY	1		45	05	34.56	-92	58	0.25		2	6	7	7
94275	45.0938333	-92.968675	airmap	24	45	45	20	10	0	0	15	1992	PED WALKWAY	MN 96	5200	16	45	5	37.80	-92	58	7.23		13	N	N	N
94276	45.0925833	-92.9661333	airmap	24	45	45	20	10	0	0	15	1992	PED WALKWAY	MN 96	5200	16	45	5	33.30	-92	57	58.08		13	N	N	N
94277	44.9843	-93.292975	airmap	24	35	35	20	0	0	0	15	1939	Bassett Creek	TH 55	20500	14	44	59	03.48	-93	17	34.71		13	N	N	N
9432	44.8836694	-93.3503417	airmap	48	35	55	0	20	0	0	15	1977	TH 100	W 66th St	3850	19	44	53	01.21	-93	21	01.23		1	7	7	5
9465	45.3192861	-93.2360083	airmap	24	35	35	20	0	0	0	15	1961	Crooked Creek	TH 65	26500	14	45	19	9.43	-93	14	9.63		15	N	N	N
9471	44.9675056	-93.2020944	airmap	48	35	55	0	20	0	0	15	1969	TH 280; 280 NB ON RAMP	TERRITORIAL RD	3750	19	44	58	03.02	-93	12	07.54		1	6	6	6
9473	45.0398778	-93.1913444	airmap	48	45	45	20	10	0	0	15	1963	MC RAIL (COUNTY 88)	TH 888A SB; 35W	8800	16	45	02	23.56	-93	11	28.84		1	7	6	6
9488	44.5216139	-92.9246361	airmap	48	35	55	0	20	0	0	15	1964	US 52	CSAH 88	1850	07	44	31	17.81	-92	55	28.69		1	6	7	7
9492	45.0403556	-93.1896139	airmap	48	55	75	0	20	10	0	25	1964	I 35W	TH 888A EB	4400	16	45	02	25.28	-93	11	22.61		7	5	5	6
9520	44.9325028	-93.1291972	airmap	48	35	55	0	20	0	0	15	1966	I 35E	CP Rail	1		44	55	57.01	-93	07	45.11		1	7	6	7
9532	44.9122083	-93.1442194	airmap	48	35	55	0	20	0	0	15	1964	I 35E	CP RAIL	1		44	54	43.95	-93	08	39.19		6	7	6	7
9578	45.0852167	-93.1867611	airmap	48	35	55	0	20	0	0	15	1963	I 35W	MC RAIL	1		45	05	06.78	-93	11	12.34		5	7	6	7
95897	45.1207361	-93.3892528	airmap	24	35	35	20	0	0	0	15	1984	STREAM	US 169	57000	14	45	7	14.65	-93	23	21.31		13	N	N	N
9600F	44.8273556	-93.2311833	airmap	48	55	55	20	20	0	0	15	1980	Minnesota River	Ped Trail	1	12	44	49	38.48	-93	13	52.26		1	6	5	7
9631	44.9508556	-93.1059278	airmap	48	55	75	0	20	10	0	25	1966	I 94, EB OFF; EB ON RP	JOHN IRELAND SB	4250	16	44	57	03.08	-93	06	21.34		7	6	5	5
9632	44.9508389	-93.1056222	airmap	48	55	75	0	20	10	0	25	1966	I 94. EB ON; OFF RAMPS	JOHN IRELAND NB	4250	16	44	57	03.02	-93	06	20.24		7	6	4	7
9663	44.9516972	-93.1364528	airmap	48	35	55	0	20	0	0	15	1961	I 94	Victoria S	4700	17	44	57	06.11	-93	08	11.23		1	6	6	6
96697	44.9912833	-93.4590833	airmap	24	35	35	20	0	0	0	15	1989	LUCE LINE TRAIL	I 494	109000	11	44	59	28.62	-93	27	32.70		13	N	N	N
9675	44.6616972	-93.0072694	airmap	48	55	55	20	10	0	0	25	1961	Vermillion River	US 52 NB	13750	02	44	39	42.11	-93	00	26.17		6	6	6	5
96758	44.8605611	-93.0591583	airmap	24	35	35	20	0	0	0	15	1990	Pedestrian Trail	US 52	54000	12	44	51	38.02	-93	03	32.97		13	N	N	N
96882	44.8626583	-93.5019694	airmap	24	35	35	20	0	0	0	15	1990	PED TUNNEL	TH 5	42000	16	44	51	45.57	-93	30	07.09		13	N	N	N
9714	45.2049444	-93.3857417	airmap	48	35	55	0	20	0	0	15	1963	US 10	Pedestrian	1		45	12	17.80	-93	23	08.67		5	7	6	6
97153	44.8611861	-93.4441389	airmap	24	45	45	20	10	0	0	15	1998	County Ditch 43	Prairie Center Dr	15034	17	44	51	40.27	-93	26	38.90		13	N	N	N
97278	44.7832556	-93.4407667	airmap	24	35	35	20	0	0	0	15	1994	DEANS LAKE OUTLET	US 169	61000	14	44	46	59.72	-93	26	26.76		13	N	N	N
97279	44.861675	-93.442275	airmap	24	35	35	20	0	0	0	15	1998	County Ditch 43	TH 5	64000	16	44	51	42.03	-93	26	32.19		13	N	N	N
9731	44.9466472	-93.2745806	airmap	48	40	60	0	0	0	25	15	1965	E 31St St	I 35W	191000	11	44	56	47.93	-93	16	28.49		1	7	6	6
9733	44.9483333	-93.2747583	airmap	48	35	35	20	0	0	0	15	1966	E Lake St	I 35W	192000	11	44	56	54.00	-93	16	29.13		1	7	6	6
97389	44.7765306	-93.5390083	airmap	24	35	35	20	0	0	0	15	1995	STREAM	US 169 WB RAMPS	36000	14	44	46	35.51	-93	32	20.43		13	N	N	N
97390	44.7761417	-93.5383917	airmap	24	35	35	20	0	0	0	15	1995	STREAM	US 169	31500	14	44	46	34.11	-93	32	18.21		13	N	N	N
97445	44.7827389	-93.4637	airmap	24	35	35	20	0	0	0	15	1994	STREAM	US 169	61000	14	44	46	57.86	-93	27	49.32		13	N	N	N
97602	44.7766528	-93.5501167	airmap	24	35	35	20	0	0	0	15	1995	STREAM	US 169	36000	14	44	46	35.95	-93	33	0.42		13	N	N	N
97603	44.7761333	-93.5251083	airmap	24	35	35	20	0	0	0	15	1995	STREAM	US 169	34000	14	44	46	34.08	-93	31	30.39		13	N	N	N
97776	44.5085611	-93.1455778	airmap	24	45	45	20	10	0	0	15	2003	Mud Creek	TH 3	5300	06	44	30	30.82	-93	08	44.08		13	N	N	N
9823	45.2031667	-93.0485389	airmap	24	35	35	20	0	0	0	15	1967	RICE CREEK	I 35W	37000	01	45	12	11.40	-93	02	54.74		13	N	N	N
9832	44.9125278	-93.14425	airmap	48	35	55	0	20	0	0	15	1965	I 35E	Montreal Ave	825	19	44	54	45.10	-93	08	39.30		1	7	7	7
9834	44.9756083	-93.4602139	airmap	48	35	55	0	20	0	0	15	1964	I 494	Chesire Lane	4100	19	44	58	32.19	-93	27	36.77		1	7	7	6
9861	45.0693778	-93.2789306	airmap	48	35	35	20	0	0	0	15	1962	E RIVER RD	I 694 WB	71000	11	45	4	9.76	-93	16	44.15		1	6	7	7
9862	45.0691556	-93.2790444	airmap	48	35	35	20	0	0	0	15	1964	E RIVER RD	I 694 EB	71000	11	45	4	8.96	-93	16	44.56		1	7	7	7
9868	45.0662417	-93.2367861	airmap	48	35	55	0	20	0	0	15	1964	I 694	MATTERHORN DR.	2600	19	45	03	58.47	-93	14	12.43		1	6	6	6
9888	44.8709917	-93.2988667	airmap	48	35	55	0	20	0	0	15	1960	I 35W	PED at 73rd Ave	1		44	52	15.57	-93	17	55.92		1	6	7	8
9892	44.9643472	-93.2401278	airmap	48	45	65	0	20	0	0	25	1962	I 94	PED at 22nd Ave	1		44	57	51.65	-93	14	24.46		1	5	6	6
9894	44.8966972	-93.3499972	airmap	48	35	55	0	20	0	0	15	1974	TH 100	Benton Ave	3200	19	44	53	48.11	-93	20	59.99		1	6	6	6
9895	44.8999861	-93.3499139	airmap	48	35	55	0	20	0	0	15	1971	TH 100, Frontage Roads	PED at S View Lane	1		44	53	59.95	-93	20	59.69		1	6	6	7
9896	44.9039111	-93.3499056	airmap	48	35	55	0	20	0	0	15	1971	TH 100, Frontage Roads	PED at Windsor Ave	1		44	54	14.08	-93	20	59.66		1	7	6	7
02007	45.2347361	-93.4718083	airmap	24	25	45	0	10	0	0	15	2015	US 10	CSAH 83	6400	16	45	14	05.05	-93	28	18.51		1	8	8	8
02010	45.2057889	-93.4007556	airmap	48	25	45	0	0	0	0	25	1964	Main St	US 10	61000	12	45	12	20.84	-93	24	02.72	_	1	6	6	5
02024	45.13855	-93.2904889	airmap	48	45	45	20	0	0	0	25	1986	East River Road	MN 610 EB	33500	12	45	08	18.78	-93	17	25.76	_	1	6	5	6
02027	45.1428333	-93.2793361	airmap	24	15	35	0	0	0	0	15	1986	Coon Rapids Blvd	MN 610 WB	27500	12	45	8	34.20	-93	16	45.61	_	1	6	8	6
02028	45.1425944	-93.2791028	airmap	48	15	35	0	0	0	0	15	1986	Coon Rapids Blvd	MN 610 EB	27500	12	45	08	33.34	-93	16	44.77	_	1	6	7	6
02031	45.1633	-93.2853861	airmap	48	25	45	0	10	0	0	15	1997	US 10	Egret Blvd	7300	17	45	09	47.88	-93	17	07.39	_	1	7	7	7
02035	45.1463	-93.26995	airmap	48	15	35	0	0	0	0	15	1997	MN 47 NB	US 10	51000	12	45	08	46.68	-93	16	11.82		1	7	7	7
02039	45.1433139	-93.2669611	airmap	48	15	35	0	0	0	0	15	1997	University Avenue	MN 610 WB	27500	12	45	08	35.93	-93	16	01.06		1	7	7	6
02040	45.1423111	-93.2665472	airmap	48	15	35	0	0	0	0	15	1997	University Avenue	MN 610 EB	27500	12	45	08	32.32	-93	15	59.57	_	1	7	7	7
02041	45.1430167	-93.2701417	airmap	48	15	35	0	0	0	0	15	1997	MN 47	MN 610 WB	27500	12	45	08	34.86	-93	16	12.51	_	1	6	7	6
02042	45.1425528	-93.27015	airmap	48	15	35	0	0	0	0	15	1997	MN 47	MN 610 EB	27500	12	45	8	33.19	-93	16	12.54	_	1	7	7	6
02043	45.1377333	-93.2457111	airmap	48	25	45	0	10	0	0	15	1998	US 10	Polk Street	5100	19	45	08	15.84	-93	14	44.56	_	1	7	7	6
02045	45.1341472	-93.2352917	airmap	48	15	35	0	0	0	0	15	1992	MN 65	US 10 WB	39500	12	45	08	02.93	-93	14	07.05	_	1	7	7	7
02046	45.1338722	-93.2352972	airmap	24	15	35	0	0	0	0	15	1992	MN 65	US 10 EB	39500	12	45	08	01.94	-93	14	07.07	_	1	6	8	7
02047	45.127625	-93.2177667	airmap	48	25	45	0	10	0	0	15	1992	US 10	Airport Road	6300	19	45	07	39.45	-93	13	03.96	_	1	7	7	8
02048	45.1248194	-93.2130278	airmap	48	25	45	0	10	0	0	15	1992	US 10	CSAH 32	14700	16	45	07	29.35	-93	12	46.90		1	7	6	7
02050	45.1900361	-93.2346278	airmap	24	15	35	0	0	0	0	15	2007	MN 65	PAUL PKWY(121 AVE)	39500	19	45	11	24.13	-93	14	04.66		1	7	8	7
02051	45.1972472	-93.2345722	airmap	24	15	35	0	0	0	0	15	2007	MN 65	MAIN ST	20000	14	45	11	50.09	-93	14	04.46		1	7	8	7
02550	45.1594583	-93.1633444	airmap	48	25	45	0	10	0	0	15	1997	I 35W	CSAH 17	11500	16	45	09	34.05	-93	09	48.04		1	7	7	7
02552	45.2043278	-93.3578194	airmap	48	15	35	0	0	0	0	15	1989	US 10	CSAH 9	45000	16	45	12	15.58	-93	21	28.15		1	7	7	7
02559	45.1976194	-93.3406	airmap	48	15	35	0	0	0	0	15	2000	US 10	Main St (CSAH 14)	33000	14	45	11	51.43	-93	20	26.16		1	7	7	7
02566	45.1425222	-93.1856306	airmap	24	15	35	0	0	0	0	15	2002	I 35W	LOVELL RD	20400	17	45	08	33.08	-93	11	08.27		1	7	8	7
02567	45.1819611	-93.3153528	airmap	24	15	35	0	0	0	0	15	2007	US 10	Hanson Blvd	29000	16	45	10	55.06	-93	18	55.27		1	7	8	7
02570	45.2027583	-93.3476028	airmap	24	25	45	0	10	0	0	15	2006	US 10	Northdale Blvd	6200	17	45	12	09.93	-93	20	51.37		1	8	8	8
02571	45.1244194	-93.188575	airmap	48	25	45	0	10	0	0	15	2006	I 35W	CO RD J (CSAH 32)	17000	16	45	07	27.91	-93	11	18.87		1	8	7	8
02804	45.2184944	-93.0291972	airmap	48	45	65	0	10	10	0	25	1967	I 35E SB	I 35W NB	18500	01	45	13	06.58	-93	01	45.11		7	5	5	5
02811	45.06855	-93.2578139	airmap	48	15	35	0	0	0	0	15	1988	7th St. NE	I 694	123000	11	45	04	06.78	-93	15	28.13		1	7	7	7
02812	45.1641389	-93.0312806	airmap	24	25	45	0	10	0	0	15	2009	I 35E	CSAH 14	16800	16	45	09	50.90	-93	01	52.61		1	8	8	8
02815	45.0677833	-93.2477417	airmap	48	15	35	0	0	0	0	15	1988	MN 65	I 694	123000	11	45	04	04.02	-93	14	51.87		1	6	6	6
02817	45.1801806	-93.1129611	airmap	24	15	35	0	0	0	0	15	2008	I 35W	CSAH 23	32712	14	45	10	48.65	-93	06	46.66		1	7	8	7
02818	45.2504722	-93.0245528	airmap	24	25	45	0	10	0	0	15	2018	I 35	MN 97	17900	06	45	15	01.70	-93	01	28.39		1	8	8	8
10024	44.7798611	-93.6346667	airmap	24	25	45	0	10	0	0	15	2008	US 212	US 912C	8000	08	44	46	47.50	-93	38	04.80		1	8	8	8
10032	44.8155056	-93.6024083	airmap	48	25	45	0	10	0	0	15	2007	US 212	MN 41	19100	14	44	48	55.82	-93	36	08.67		1	8	7	7
10037	44.8210306	-93.5753861	airmap	24	15	35	0	0	0	0	15	2007	US 212	AUDUBON ROAD	30000	16	44	49	15.71	-93	34	31.39		1	7	8	7
10038	44.8346417	-93.5525333	airmap	48	25	45	0	10	0	0	15	2007	US 212	POWERS BLVD	8100	17	44	50	04.71	-93	33	09.12		1	7	7	6
10039	44.8407861	-93.5456611	airmap	48	25	45	0	10	0	0	15	2007	US 212	LYMAN BLD	6100	16	44	50	26.83	-93	32	44.38		1	8	7	7
10040	44.8442583	-93.53875	airmap	24	25	45	0	10	0	0	15	2007	US 212	GREAT PLAINS BLVD	10600	19	44	50	39.33	-93	32	19.50		1	8	8	8
10041	44.8277778	-93.5601194	airmap	48	25	45	0	10	0	0	15	2007	US 212	PIONEER TRAIL	10900	16	44	49	40.00	-93	33	36.43		1	8	7	7

13001	45.3907139	-92.8532028	airmap	24	25	45	0	10	0	0	15	2012	CHANNEL	US 8	16500	02	45	23	26.57	-92	51	11.53	1	7	8	8
13801	45.3364806	-93.0046917	airmap	48	25	45	0	10	0	0	15	1967	I 35	US 61	13800	06	45	20	11.33	-93	00	16.89	1	6	7	6
13802	45.3968861	-92.9948417	airmap	48	25	45	0	10	0	0	15	1967	I 35	CSAH 19	10000	07	45	23	48.79	-92	59	41.43	1	6	7	6
13808	45.6842083	-92.9898222	airmap	48	25	45	0	10	0	0	15	1968	I 35	CSAH 1	7100	07	45	41	03.15	-92	59	23.36	1	7	6	7
13809	45.5101917	-92.9931556	airmap	24	15	35	0	0	0	0	15	2010	I 35	TH 95	20600	06	45	30	36.69	-92	59	35.36	1	8	8	8
19005	44.7390472	-93.0350278	airmap	24	15	35	0	0	0	0	15	2017	CSAH 42	US 52 SB	29000	02	44	44	20.57	-93	02	06.10	1	8	8	8
19006	44.7390111	-93.0347278	airmap	24	15	35	0	0	0	0	15	2017	CSAH 42	US 52 NB	29000	02	44	44	20.44	-93	02	05.02	1	8	8	8
19014	44.8199611	-93.2238028	airmap	48	35	35	20	0	0	0	15	1978	UP RR	TH 77 NB	47000	12	44	49	11.86	-93	13	25.69	1	7	5	7
19015	44.8849611	-93.06365	airmap	48	15	35	0	0	0	0	15	1973	SOUTH VIEW BLVD	US 52 SB	30500	12	44	53	05.86	-93	03	49.14	1	7	6	7
19016	44.8850833	-93.0633917	airmap	48	15	35	0	0	0	0	15	1973	SOUTH VIEW BLVD	US 52 NB	30500	12	44	53	06.30	-93	03	48.21	1	7	7	7
19018	44.90155	-93.0655889	airmap	48	35	55	0	10	0	0	25	1972	US 52	Thompson Ave(CR 6)	10600	19	44	54	05.58	-93	03	56.12	1	6	6	5
19020	44.89795	-93.0659028	airmap	48	15	35	0	0	0	0	15	1972	WENTWORTH AVE	US 52 NB	30500	12	44	53	52.62	-93	03	57.25	1	7	7	7
19021	44.9123583	-93.0642556	airmap	48	25	45	0	10	0	0	15	1972	US 52	Butler Ave (CR 4)	12200	17	44	54	44.49	-93	03	51.32	1	7	6	5
19022	44.8479222	-93.0596778	airmap	48	25	45	0	10	0	0	15	1990	US 52	CSAH 26	12300	16	44	50	52.52	-93	03	34.84	1	7	7	7
19023	44.8239333	-93.0577306	airmap	48	35	55	0	10	0	0	25	1992	US 52 SB	TH 55 WB	9200	14	44	49	26.16	-93	03	27.83	1	6	6	5
19036	44.7728694	-93.3048778	airmap	24	25	45	0	10	0	0	15	2013	TH 13	CSAH 5	8100	16	44	46	22.33	-93	18	17.56	1	8	8	7
19037	44.8775167	-93.0805333	airmap	48	25	45	0	10	0	0	15	1984	TH 3	TH 110 WB	9000	16	44	52	39.06	-93	04	49.92	1	7	7	6
19038	44.877225	-93.0805278	airmap	48	25	45	0	10	0	0	15	1984	TH 3	TH 110 EB	9000	16	44	52	38.01	-93	04	49.90	1	7	7	7
19041	44.8334167	-93.0596111	airmap	48	25	45	0	10	0	0	15	1991	US 52	80TH ST E	11300	16	44	50	0.3	-93	03	34.6	1	7	7	7
19042	44.8656583	-93.0599583	airmap	48	25	45	0	10	0	0	15	1988	US 52	Upper 55th St	12800	17	44	51	56.37	-93	03	35.85	1	7	7	6
19045	44.8337806	-93.0865889	airmap	48	25	45	0	10	0	0	15	1994	TH 55	TH 3	7000	16	44	50	01.61	-93	05	11.72	1	7	6	7
19047	44.8159944	-93.0443639	airmap	48	15	35	0	0	0	0	15	1994	Concord Blvd	US 52 NB	24750	14	44	48	57.58	-93	02	39.71	1	6	7	6
19048	44.8158111	-93.0447528	airmap	48	15	35	0	0	0	0	15	1994	Concord Blvd	US 52 SB	24750	14	44	48	56.92	-93	02	41.11	1	7	7	6
19053	44.8047556	-93.2210556	airmap	48	35	55	0	10	0	0	25	1978	TH 77	CSAH 30	17400	16	44	48	17.12	-93	13	15.8	1	6	6	5
19055	44.8153111	-93.2212611	airmap	48	25	45	0	10	0	0	15	1978	SB TH 77	TH 13 SB	12500	16	44	48	55.12	-93	13	16.54	1	7	6	6
19067	44.7902806	-93.2214139	airmap	48	25	45	0	0	0	0	25	1979	TH 77	CSAH 32	38000	14	44	47	25.01	-93	13	17.09	1	6	6	5
19076	44.9036833	-93.13385	airmap	48	25	45	0	10	0	0	15	1983	Lilydale Road	TH 13	8850	17	44	54	13.26	-93	8	1.86	1	7	7	7
19077	44.9103556	-93.1238111	airmap	48	25	45	0	10	0	0	15	1979	HAPPY HOLLOW	TH 13	9400	17	44	54	37.28	-93	7	25.72	8	7	7	7
19081	44.7596972	-93.2177667	airmap	48	25	45	0	10	0	0	15	1985	TH 77; SB OFF RAMP	CSAH 38	16400	16	44	45	34.91	-93	13	3.96	1	7	6	6
19082	44.7658694	-93.2175861	airmap	48	25	45	0	10	0	0	15	1983	TH 77	127 ST	5400	19	44	45	57.13	-93	13	03.31	1	6	7	5
19087	44.8833194	-93.1698917	airmap	48	15	35	0	0	0	0	15	1993	SIBLEY MEMORIAL; BIKE	TH 55 WB	21250	12	44	52	59.95	-93	10	11.61	1	7	7	7
19088	44.8830722	-93.1700972	airmap	48	15	35	0	0	0	0	15	1993	SIBLEY MEMORIAL; BIKE	TH 55 EB	21250	12	44	52	59.06	-93	10	12.35	1	7	7	7
19089	44.8823583	-93.1652056	airmap	48	25	45	0	10	0	0	15	1993	MN 62 (OLD 110)	TH 55 WB	13000	14	44	52	56.49	-93	9	54.74	1	7	7	7
19522	44.7524083	-93.2861556	airmap	48	25	45	0	10	0	0	15	1984	I 35W	CSAH 38	17400	16	44	45	08.67	-93	17	10.16	1	6	6	6
19527	44.7457417	-93.2829806	airmap	48	15	35	0	0	0	0	15	1989	I 35W	CSAH 42	53000	14	44	44	44.67	-93	16	58.73	1	7	6	7
19531	44.7145056	-93.2835694	airmap	48	15	35	0	0	0	0	15	1995	I 35	CSAH 46	33000	16	44	42	52.22	-93	17	0.85	1	7	7	6
19807	44.6978444	-93.288375	airmap	48	25	45	0	0	0	0	25	1965	CSAH 50	I 35 SB	38500	11	44	41	52.24	-93	17	18.15	1	6	6	5
19808	44.6976889	-93.2881861	airmap	48	15	35	0	0	0	0	15	1965	CSAH 50	I 35 NB	38500	11	44	41	51.68	-93	17	17.47	1	7	7	6
19809	44.7398944	-93.2830583	airmap	48	25	45	0	10	0	0	15	1964	I 35W	I 35E SB	19500	11	44	44	23.62	-93	16	59.01	1	7	7	6
19810	44.8274583	-93.17025	airmap	48	25	45	0	10	0	0	15	2012	I 35E; RAMPS	DUCKWOOD DR	5700	17	44	49	38.85	-93	10	12.90	1	7	7	6
19811	44.7434889	-93.2774722	airmap	48	25	45	0	10	0	0	15	1978	CSAH 42	I 35E SB	19500	11	44	44	36.56	-93	16	38.9	1	6	7	7
19812	44.7433444	-93.2772	airmap	48	25	45	0	10	0	0	15	1978	CSAH 42	I 35E NB	19500	11	44	44	36.04	-93	16	37.92	1	6	6	6
19813	44.7595472	-93.2479861	airmap	48	15	35	0	0	0	0	15	1979	CSAH 11	I 35E SB	26500	11	44	45	34.37	-93	14	52.75	1	7	6	6
19814	44.759225	-93.2480083	airmap	48	15	35	0	0	0	0	15	1979	CSAH 11	I 35E NB	26500	11	44	45	33.21	-93	14	52.83	1	7	6	6
19816	44.7901833	-93.2015528	airmap	48	15	35	0	0	0	0	15	1983	I 35E	CLIFF RD (CSAH 32)	29000	14	44	47	24.66	-93	12	05.59	1	6	7	5
19817	44.8044861	-93.190575	airmap	48	35	55	0	10	0	0	25	1984	I 35E	CSAH 30	18700	16	44	48	16.15	-93	11	26.07	1	5	6	5
19818	44.8306111	-93.1672861	airmap	48	25	45	0	0	0	0	25	1984	I 35E SB off ramp	CSAH 31-Pilot Knob	22045	16	44	49	50.2	-93	10	02.23	1	6	6	5
19819	44.858825	-93.1458806	airmap	48	25	45	0	0	0	0	25	1981	I 35E, NB COL, SB ON RMP	TH 55	20300	14	44	51	31.77	-93	08	45.17	1	5	6	5
19820	44.9013417	-93.1360556	airmap	48	25	45	0	10	0	0	15	1992	35E	TH 13	8850	17	44	54	04.83	-93	08	09.80	1	7	7	7
19823	44.8629639	-93.1452111	airmap	48	25	45	0	0	0	0	25	1982	I 35E	I 494 WB	43000	11	44	51	46.67	-93	08	42.76	1	6	6	5
19824	44.8626833	-93.1452111	airmap	48	25	45	0	0	0	0	25	1982	I 35E	I 494 EB	43000	11	44	51	45.66	-93	08	42.76	1	6	6	5
19826	44.8611917	-93.1671361	airmap	48	25	45	0	10	0	0	15	1972	I 494	Pilot Knob CSAH 31	16800	16	44	51	40.29	-93	10	01.69	1	6	7	6
19827	44.8618556	-93.1503361	airmap	48	25	45	0	0	0	0	25	1981	I 494, EB COL, EB RMP	TH 55	20300	14	44	51	42.68	-93	09	01.21	1	5	7	5
19832	44.8729361	-93.0805361	airmap	48	25	45	0	10	0	0	15	1985	I 494	TH 3	9700	16	44	52	22.57	-93	04	49.93	1	5	7	7
19836	44.8479389	-93.1531139	airmap	48	35	55	0	10	0	0	25	1983	I 35E	CSAH 26	15000	16	44	50	52.58	-93	09	11.21	1	6	6	5
19837	44.8747944	-93.0526361	airmap	48	45	65	0	20	0	0	25	1983	I 494	Blaine Avenue East	3300	19	44	52	29.26	-93	03	09.49	1	6	5	5
19843	44.6525917	-93.294975	airmap	48	15	35	0	0	0	0	15	1965	CR 64 (205TH ST)	I 35 SB	24500	11	44	39	09.33	-93	17	41.91	1	5	7	7
19844	44.6525417	-93.2946333	airmap	48	15	35	0	0	0	0	15	1965	CR 64 (205TH ST)	I 35 NB	24500	11	44	39	09.15	-93	17	40.68	1	6	7	7
19850	44.6452556	-93.2961056	airmap	24	15	35	0	0	0	0	15	2009	I 35	CSAH 70	25000	16	44	38	42.92	-93	17	45.98	1	7	8	7
19851	44.8908167	-93.1312806	airmap	48	15	35	0	0	0	0	15	1966	Marie Avenue	I 35E	81000	11	44	53	26.94	-93	07	52.61	1	6	6	6
19854	44.8748167	-93.0645806	airmap	48	35	55	0	10	0	0	25	1985	I 494; RAMPS	CSAH73 BABCOCK TRL	6600	17	44	52	29.34	-93	03	52.49	1	6	6	5
19857	44.8627028	-93.1295556	airmap	48	15	35	0	0	0	0	15	1984	I 494	TH 149	21000	16	44	51	45.73	-93	07	46.40	1	6	6	6
19859	44.77815	-93.2174306	airmap	48	15	35	0	0	0	0	15	1979	I 35E, COLL ROADS	TH77 SB	35000	12	44	46	41.34	-93	13	02.75	1	6	7	5
19860	44.7784583	-93.2170861	airmap	48	15	35	0	0	0	0	15	1979	I 35E, COLL ROADS	TH 77 NB	35000	12	44	46	42.45	-93	13	1.51	1	6	7	7
19864	44.8335361	-93.1637389	airmap	48	25	45	0	0	0	0	25	1984	I 35E, NB ON RAMP	CSAH 28	35000	16	44	50	0.73	-93	09	49.46	1	6	6	5
19866	44.7537472	-93.2611	airmap	48	15	35	0	0	0	0	15	1979	I 35E	CSAH 38	22000	16	44	45	13.49	-93	15	39.96	1	7	6	6
19878	44.8624083	-93.1452389	airmap	48	35	55	0	10	0	0	25	1982	I 494/I 35E south ramp	EB 494 to NB 35E	6000	11	44	51	44.67	-93	08	42.86	1	6	6	5
19882	44.7945639	-93.19815	airmap	48	35	55	0	10	0	0	25	1983	I 35E	Blackhawk Road	9000	17	44	47	40.43	-93	11	53.34	1	6	6	5
19883	44.81115	-93.1839139	airmap	48	45	65	0	20	0	0	25	1984	I 35E	Deerwood Drive	4650	19	44	48	40.14	-93	11	02.09	1	6	5	5
19884	44.8757889	-93.0754972	airmap	48	25	45	0	10	0	0	15	1985	I 494 WB ON RAMP	TH 110 WB	10750	16	44	52	32.84	-93	04	31.79	1	6	6	6
19889	44.7492056	-93.2682639	airmap	48	25	45	0	10	0	0	15	1979	I 35E	Portland Avenue	8000	19	44	44	57.14	-93	16	05.75	1	6	6	6
19891	44.7372694	-93.2834389	airmap	48	15	35	0	0	0	0	15	1980	SOTHCROSS DRIVE	I 35W SB	26000	11	44	44	14.17	-93	17	0.38	1	6	7	7
19892	44.7372056	-93.2831583	airmap	48	15	35	0	0	0	0	15	1980	SOTHCROSS DRIVE	I 35W NB	26000	11	44	44	13.94	-93	16	59.37	1	6	6	6
19893	44.7375194	-93.2845694	airmap	48	25	45	0	10	0	0	15	1979	Southcross Drive	I 35E SB	19500	11	44	44	15.07	-93	17	04.45	1	6	6	6
19897	44.8626778	-93.1481889	airmap	48	15	35	0	0	0	0	15	1983	WB OFF RAMP TO I 35E	I 494 WB	43000	11	44	51	45.64	-93	08	53.48	1	6	6	7
19898	44.8623167	-93.1481694	airmap	48	15	35	0	0	0	0	15	1983	OFF RAMP TO I 35E SB	I 494 EB	43000	11	44	51	44.34	-93	08	53.41	1	6	6	7
19900	44.8620556	-93.1482306	airmap	48	25	45	0	10	0	0	15	1983	OFF RAMP TO 35E SB	494 EB SOTH RAMP	6000	11	44	51	43.40	-93	08	53.63	1	6	6	7
19903	44.6812944	-93.2936083	airmap	24	15	35	0	0	0	0	15	2004	185th ST W(CSAH 60)	I 35 SB	24500	11	44	40	52.66	-93	17	36.99	1	7	8	7
19904	44.6813722	-93.2932361	airmap	24	15	35	0	0	0	0	15	2004	185th ST W (CSAH 60)	I 35 NB	24500	11	44	40	52.94	-93	17	35.65	1	8	8	7
19R01	44.7783917	-93.0347889	airmap	24	25	45	0	10	0	0	15	2003	US 52	117TH ST E	6800	16	44	46	42.21	-93	02	05.24	1	7	8	6
19R04	44.710925	-93.0324333	airmap	48	25	45	0	10	0	0	15	2004	US 52	County Road 46	5700	06	44	42	39.33	-93	01	56.76	1	7	6	6
27000	44.9660694	-93.2698444	airmap	24	15	35	0	0	0	0	15	2018	I 94	TH 65	38000	14	44	57	57.85	-93	16	11.44	1	8	8	8
27009	44.9716944	-93.4929972	airmap	48	25	45	0	0	0	0	25	1970	CSAH 15; RAMP	US 12	55000	14	44	58	18.10	-93	29	34.79	1	6	6	5
27014	44.9831417	-93.4006722	airmap	48	15	35	0	0	0	0	15	1966	TH 55 (OLSON MEMORIAL)	US 169	97000	12	44	58	59.31	-93	24	02.42	1	6	6	6
27021	44.8957944	-93.2472139	airmap	48	25	45	0	0	0	0	25	1962	TH 77	TH 62 WB	48500	12	44	53	44.86	-93	14	49.97	1	6	6	5
27022	44.8955389	-93.2472	airmap	48	25	45	0	0	0	0	25	1962	TH 77	TH 62 EB	48500	12	44	53	43.94	-93	14	49.92	1	5	6	6
27023	44.9774389	-93.3442083	airmap	48	25	45	0	10	0	0	15	1989	CSAH 40; TH 100	GLENWOOD AVE	9450	16	44	58	38.78	-93	20	39.15	1	7	6	7
27029	44.9103278	-93.3507167	airmap	48	25	45	0	10	0	0	15	1970	TH 100; RAMPS	EDEN AVE	8600	19	44	54	37.18	-93	21	02.58	1	6	7	7
27033	44.9345139	-93.3968361	airmap	48	15	35	0	0	0	0	15	1981	US 169	TH 7	37000	14	44	56	04.25	-93	23	48.61	1	6	6	7
27041	45.0589222	-93.3087222	airmap	48	25	45	0	10	0	0	15	1967	TH 100	BASS LAKE ROAD	14200	16	45	03	32.12	-93	18	31.40	1	7	6	7
27042	45.0601194	-93.3068	airmap	48	35	55	0	10	0	0	25	1970	TH 100; OFF RAMP	JOHN MARTIN DRIVE	6000	19	45	03	36.43	-93	18	24.48	1	6	6	5
27045	44.852275	-93.2474361	airmap	48	25	45	0	10	0	0	15	1988	KILLEBREW DR	TH 77 SB on ramp	5000	12	44	51	08.19	-93	14	50.77	1	7	6	6
27046	44.8526806	-93.2474278	airmap	48	25	45	0	10	0	0	15	1988	TH 77; NB C/D	KILLEBREW DR	5000	12	44	51	09.65	-93	14	50.74	1	6	6	7
27047	44.8567889	-93.2472528	airmap	48	45	65	0	20	0	0	25	1988	81 ST	TH 77 SB on ramp	1600	12	44	51	24.44	-93	14	50.11	1	6	5	5
27049	44.8599361	-93.2479944	airmap	48	25	45	0	10	0	0	15	1989	AMERICAN BLVD	TH 77 SB ON RAMP	10000	12	44	51	35.77	-93	14	52.78	1	7	7	7
27051	44.8599556	-93.2474583	airmap	48	15	35	0	0	0	0	15	1988	AMERICAN BLVD	TH 77	95000	12	44	51	35.84	-93	14	50.85	8	6	6	7
27051A	44.8599694	-93.2476667	airmap	48	25	45	0	10	0	0	15	1988	AMERICAN BLVD	TH 77 SB off ramp	7000	12	44	51	35.89	-93	14	51.60	8	7	7	7
27052A	44.8611972	-93.2465056	airmap	48	35	55	0	10	0	0	25	1989	79TH ST; TH 77 ON RAMP	TH 77 NB, WB 494	10000	12	44	51	40.31	-93	14	47.42	1	6	6	5
27052B	44.8621944	-93.2456806	airmap	48	25	45	0	10	0	0	15	1989	I 494; TH 77 NB ON RAMP	TH 77 NB ON RAMP	10000	12	44	51	43.90	-93	14	44.45	1	7	7	7
27052C	44.8610611	-93.2464056	airmap	48	25	45	0	10	0	0	15	1989	AM BLVD; 494/5 RAMPS	TH 77 NB COLL RD	10000	12	44	51	39.82	-93	14	47.06	1	6	6	7
27052D	44.8621722	-93.2454611	airmap	48	25	45	0	10	0	0	15	1989	I 494; TH 77 NB ON RAMP	TH 77 NB ON RAMP	10000	12	44	51	43.82	-93	14	43.66	1	7	6	7
27053	44.8637417	-93.2475806	airmap	48	25	45	0	0	0	0	25	1988	NB off ramp to WB 494	TH 77 SB	36000	12	44	51	49.47	-93	14	51.29	1	6	6	5
27053A	44.8639611	-93.2477417	airmap	48	25	45	0	10	0	0	15	1988	TH 77 NB off to I 494 WB	TH 77 SB on ramp	8000	12	44	51	50.26	-93	14	51.87	1	6	6	7
27054	44.92595	-93.4474028	airmap	48	25	45	0	10	0	0	15	1969	TH 7	Baker Rd (CSAH 60)	8250	16	44	55	33.42	-93	26	50.65	1	6	6	7
27056	44.8600111	-93.2467944	airmap	48	25	45	0	10	0	0	15	1988	AMERICAN BLVD	TH 77 NB OFF RMP	6000	12	44	51	36.04	-93	14	48.46	1	7	6	7
27058	44.8599361	-93.2464028	airmap	48	25	45	0	10	0	0	15	1988	AMERICAN BLVD	TH 77 Coll Rd	6000	12	44	51	35.77	-93	14	47.05	1	7	7	6
27061	44.8924306	-93.2943806	airmap	48	45	65	0	20	0	0	25	1962	TH 121	PED at 61st St	1		44	53	32.75	-93	17	39.77	1	6	5	6
27062	44.8408444	-93.2443306	airmap	48	25	45	0	10	0	0	15	1978	TH 77	Old Shakopee Rd	8750	16	44	50	27.04	-93	14	39.59	1	6	6	6
27063	44.9601333	-93.2466889	airmap	48	15	35	0	0	0	0	15	1995	CEDAR AVE	TH 55 WB	21500	14	44	57	36.48	-93	14	48.08	1	7	7	7
27070	44.8637139	-93.2473306	airmap	48	15	35	0	0	0	0	15	1988	77 NB off ramp to WB 494	TH 77 NB	36000	12	44	51	49.37	-93	14	50.39	1	6	6	7
27071	44.9626	-93.2492278	airmap	48	15	35	0	0	0	0	15	1995	FRANKLIN AVE	TH 55 WB	21500	14	44	57	45.36	-93	14	57.22	1	7	7	7
27078	44.8890222	-93.4073111	airmap	48	45	65	0	10	10	0	25	1968	TH 212; SB ON RAMP	TH 62 EB	18500	12	44	53	20.48	-93	24	26.32	7	6	5	6
27079	44.8906556	-93.3995361	airmap	48	15	35	0	0	0	0	15	1968	US 212; TH 62	US 169 SB	43000	12	44	53	26.36	-93	23	58.33	1	8	7	7
27080	44.8907361	-93.3992917	airmap	48	15	35	0	0	0	0	15	1968	US 212; TH 62	US 169 NB	43000	12	44	53	26.65	-93	23	57.45	1	8	7	7
27082	44.8895944	-93.3869778	airmap	48	25	45	0	10	0	0	15	1966	TH 62	Gleason Road	8900	16	44	53	22.54	-93	23	13.12	1	6	7	5
27083	44.887475	-93.3689889	airmap	48	35	55	0	10	0	0	25	1965	TH 62	Tracy Ave	9000	17	44	53	14.91	-93	22	08.36	1	6	6	5
27087	44.8665194	-93.4198694	airmap	48	25	45	0	10	0	0	15	1971	US 212	Valley View Rd	17400	16	44	51	59.47	-93	25	11.53	1	6	7	7
27100	44.9701083	-93.2693472	airmap	48	25	45	0	10	0	0	15	1966	TH 65	11 ST S	19400	19	44	58	12.39	-93	16	09.65	1	6	6	7
27102	44.9124528	-93.3507472	airmap	48	15	35	0	0	0	0	15	1970	TH 100	50th St W	20200	16	44	54	44.83	-93	21	02.69	1	6	7	6
27104	44.918775	-93.3497694	airmap	48	15	35	0	0	0	0	15	1970	44th St	TH 100	102000	12	44	55	07.59	-93	20	59.17	1	7	7	7
27105	44.9266917	-93.3495111	airmap	48	45	65	0	20	0	0	25	1968	TH 100; VERNON AVE	PED AT 41ST ST	1		44	55	36.09	-93	20	58.24	1	6	4	7
27106	44.9302639	-93.3499611	airmap	48	15	35	0	0	0	0	15	1968	TH 100; SB OFF RAMP	EXCELSIOR BLVD	28500	16	44	55	48.95	-93	20	59.86	1	7	7	7
27107	44.8896194	-93.1862056	airmap	48	25	45	0	10	0	0	15	1992	TH 55	TH 5 EB off ramp	9000	12	44	53	22.63	-93	11	10.34	1	6	7	7
27108	44.8922917	-93.1878389	airmap	48	15	35	0	0	0	0	15	1992	TH 5 EB off ramp	TH 55 EB	28500	12	44	53	32.25	-93	11	16.22	1	7	7	7
27109	44.9377583	-93.3492194	airmap	48	25	45	0	10	0	0	15	1984	TH 100; RAMPS	W 36TH ST	13200	17	44	56	15.93	-93	20	57.19	1	6	6	7
27112	44.8913944	-93.1847444	airmap	48	15	35	0	0	0	0	15	1992	TH 5; WB COLL RD	TH 55	57000	12	44	53	29.02	-93	11	05.08	1	7	7	7
27116	44.8921472	-93.1877528	airmap	48	15	35	0	0	0	0	15	1992	Bloomington Road	TH 55 EB	28500	12	44	53	31.73	-93	11	15.91	1	7	7	7

27117	44.97115	-93.432975	airmap	48	15	35	0	0	0	0	15	1988	Ridgedale Drive	I 394 WB	49000	11	44	58	16.14	-93	25	58.71	1	7	7	7
27118	44.8902389	-93.1864083	airmap	48	25	45	0	10	0	0	15	1992	TH 5 WB ramp	TH 5 EB ramp to 55	9000	12	44	53	24.86	-93	11	11.07	1	7	7	7
27120	44.9708778	-93.4329139	airmap	48	15	35	0	0	0	0	15	1973	Ridgedale Drive	I 394 EB	49000	11	44	58	15.16	-93	25	58.49	1	7	7	7
27121	44.9845472	-93.3490972	airmap	24	15	35	0	0	0	0	15	2000	TH 55	TH 100	90000	12	44	59	04.37	-93	20	56.75	1	7	8	7
27129	44.9748972	-93.5304194	airmap	48	35	55	0	10	0	0	25	1972	US 12	CSAH 15	12700	16	44	58	29.63	-93	31	49.51	1	6	6	5
27132	44.9760944	-93.5085917	airmap	48	25	45	0	10	0	0	15	1970	US 12	Broadway Ave	8000	19	44	58	33.94	-93	30	30.93	1	7	6	5
27133	44.9759944	-93.5021139	airmap	48	35	55	0	10	0	0	25	1970	US 12	Central Ave	16500	16	44	58	33.58	-93	30	07.61	1	5	6	5
27137	44.8493528	-93.5043861	airmap	24	25	45	0	10	0	0	15	2006	US 212	DELL RD	6900	16	44	50	57.67	-93	30	15.79	1	7	8	8
27138	44.8516917	-93.4848417	airmap	48	25	45	0	10	0	0	15	1999	US 212	Eden Prairie Rd	10900	16	44	51	06.09	-93	29	05.43	1	7	7	7
27145	44.8616944	-93.4700861	airmap	48	15	35	0	0	0	0	15	1998	WALLACE RD	US 212 WB	22000	14	44	51	42.10	-93	28	12.31	1	7	7	7
27146	44.8614806	-93.4701	airmap	48	15	35	0	0	0	0	15	1998	WALLACE RD	US 212 EB	22000	14	44	51	41.33	-93	28	12.36	1	7	7	7
27147	44.8619472	-93.4597639	airmap	48	25	45	0	10	0	0	15	1998	US 212	MITCHELL RD	13200	16	44	51	43.01	-93	27	35.15	1	7	7	7
27148	44.8623556	-93.4430306	airmap	48	25	45	0	10	0	0	15	1998	US 212	PRAIRIE CENTER DR	15600	17	44	51	44.48	-93	26	34.91	1	7	7	7
27150	44.8610194	-93.4701	airmap	48	15	35	0	0	0	0	15	1998	WALLACE RD	TH 5 EB	23500	16	44	51	39.67	-93	28	12.36	1	7	7	8
27169	44.892275	-93.1878389	airmap	48	15	35	0	0	0	0	15	1968	TH 5 EB OFF RAMP	TH 55 WB	28500	12	44	53	32.19	-93	11	16.22	1	6	6	7
27171	44.8932944	-93.190375	airmap	48	15	35	0	0	0	0	15	1968	Bloomington Rd	TH 55 WB	28500	12	44	53	35.86	-93	11	25.35	1	6	7	7
27177	44.9623611	-93.2493944	airmap	48	25	45	0	0	0	0	25	1967	FRANKLIN AVE	TH 55 EB	21500	14	44	57	44.5	-93	14	57.82	1	4	6	6
27178	44.9599833	-93.2467194	airmap	48	15	35	0	0	0	0	15	1967	CEDAR AVE	TH 55 EB	21500	14	44	57	35.94	-93	14	48.19	1	7	7	7
27203	45.0363778	-93.3429861	airmap	24	25	45	0	10	0	0	15	2001	TH 100	CSAH 81	17900	16	45	02	10.96	-93	20	34.75	1	7	8	8
27204	44.9927333	-93.6190806	airmap	48	25	45	0	10	0	0	15	2007	SOIL	RAMP(US 12 EB OFF)	16800	14	44	59	33.84	-93	37	08.69	1	7	7	7
27210	44.8641972	-93.3500972	airmap	48	25	45	0	10	0	0	15	1974	TH 100	W 77th St	12500	16	44	51	51.11	-93	21	0.35	1	6	6	7
27212	44.9915306	-93.6168472	airmap	48	25	45	0	10	0	0	15	2007	SOIL	RAMP(US 12 EB ON)	17700	14	44	59	29.51	-93	37	0.65	1	8	7	5
27214	45.1196639	-93.3087611	airmap	48	25	45	0	10	0	0	15	1998	MET Council Sewer Pipe	MN 610 EB	9000	14	45	07	10.79	-93	18	31.54	1	7	7	7
27221	45.1241278	-93.3359083	airmap	24	25	45	0	10	0	0	15	1997	TH 610	Noble Avenue	14000	17	45	07	26.86	-93	20	09.27	1	7	8	8
27223	45.1279333	-93.3563389	airmap	48	25	45	0	10	0	0	15	1999	TH 610	Zane Ave	9800	16	45	07	40.56	-93	21	22.82	1	6	6	6
27224	45.1296778	-93.3664389	airmap	48	45	65	0	20	0	0	25	1999	TH 610	Hampshire Avenue N	600	19	45	07	46.84	-93	21	59.18	1	6	5	6
27225	45.1298028	-93.3766333	airmap	48	25	45	0	10	0	0	15	1998	TH 610	W Broadway Avenue	11800	16	45	07	47.29	-93	22	35.88	1	6	6	7
27230	45.1277667	-93.4867083	airmap	24	25	45	0	10	0	0	15	2017	TH 610	MAPLE GROVE PKWY	5900	16	45	07	39.96	-93	29	12.15	1	8	8	8
27233	45.1303139	-93.3909611	airmap	48	25	45	0	10	0	0	15	1998	US 169	TH 610 WB	16750	14	45	07	49.13	-93	23	27.46	1	7	7	7
27234	45.1299778	-93.3909139	airmap	48	25	45	0	10	0	0	15	1998	US 169	TH 610 EB	17000	14	45	7	47.92	-93	23	27.29	1	6	7	7
27250	45.1303222	-93.4019472	airmap	24	25	45	0	10	0	0	15	2010	TH 610	JEFFERSON HWY	7600	17	45	07	49.16	-93	24	07.01	1	7	8	7
27267	45.0473583	-93.5471333	airmap	24	15	35	0	0	0	0	15	2000	WET LANDS	TH 55 WB	20900	14	45	02	50.49	-93	32	49.68	9	7	8	8
27268	45.0471972	-93.5471722	airmap	24	15	35	0	0	0	0	15	2000	WET LANDS	TH 55 EB	20900	14	45	02	49.91	-93	32	49.82	9	8	8	8
27279	44.9758528	-93.5413444	airmap	24	25	45	0	10	0	0	15	2007	US 12	CSAH 112	8400	16	44	58	33.07	-93	32	28.84	1	7	8	8
27283	44.9992306	-93.3493722	airmap	48	15	35	0	0	0	0	15	2003	Duluth St	TH 100	71000	12	44	59	57.23	-93	20	57.74	1	7	7	7
27285	45.0314778	-93.3471139	airmap	48	25	45	0	10	0	0	15	2001	TH 100	42ND AVE N (CR 9)	19600	16	45	01	53.32	-93	20	49.61	1	6	7	7
27291	44.8836444	-93.2469111	airmap	24	25	45	0	10	0	0	15	2005	TH 77	WB 66th ST	10600	17	44	53	01.12	-93	14	48.88	1	7	8	7
27294	44.8188889	-93.3982778	airmap	48	25	45	0	10	0	0	15	2004	US 169	PIONEER TRAIL	9050	16	44	49	08.00	-93	23	53.80	1	7	7	7
27295	44.8369306	-93.3984667	airmap	48	25	45	0	10	0	0	15	2004	US 169	ANDERSON LAKES PKW	13500	16	44	50	12.95	-93	23	54.48	1	7	7	7
27296	44.9864889	-93.6070306	airmap	48	25	45	0	10	0	0	15	2007	UNSTABLE SOIL	US 12	17700	14	44	59	11.36	-93	36	25.31	1	7	7	6
27298	45.1235111	-93.3891222	airmap	24	25	45	0	10	0	0	15	2013	TH 169; RAMPS	93RD AVE N	8700	16	45	07	24.64	-93	23	20.84	1	8	8	8
27299	45.21035	-93.5525444	airmap	24	15	35	0	0	0	0	15	2014	CSAH 144	TH 101	40000	02	45	12	37.26	-93	33	09.16	1	8	8	8
27301	44.9379167	-93.369475	airmap	24	15	35	0	0	0	0	15	2013	LOUISIANA AVE	TH 7	37000	14	44	56	16.50	-93	22	10.11	1	8	8	7
27305	44.9437306	-93.3479528	airmap	24	15	35	0	0	0	0	15	2014	TH 100	TH 7 (CSAH 25)	31000	14	44	56	37.43	-93	20	52.63	1	7	8	7
27306	44.9485083	-93.3479	airmap	24	25	45	0	10	0	0	15	2015	TH 100	MINNETONKA BLVD	19100	16	44	56	54.63	-93	20	52.44	1	7	8	8
27408	44.8612528	-93.3188389	airmap	24	25	45	0	10	0	0	15	2013	I 494	XERXES AVE	7800	17	44	51	40.51	-93	19	07.82	1	7	8	7
27411	44.9813083	-93.2442028	airmap	48	15	35	0	0	0	0	15	2008	2ND ST	TH 35W SB	55000	11	44	58	52.71	-93	14	39.13	9	7	7	7
27412	44.9811583	-93.2439639	airmap	24	15	35	0	0	0	0	15	2008	2ND ST	TH 35W NB	77000	11	44	58	52.17	-93	14	38.27	9	8	8	7
27414	44.9810861	-93.2436917	airmap	24	15	35	0	0	0	0	15	2008	2ND ST	TH 35W NB EXIT RMP	77000	11	44	58	51.91	-93	14	37.29	9	7	8	7
27504	44.8908306	-93.3188083	airmap	48	25	45	0	10	0	0	15	1962	TH 62	Xerxes Ave	14800	17	44	53	26.99	-93	19	07.71	1	7	6	6
27521	44.8974917	-93.2323833	airmap	48	15	35	0	0	0	0	15	1964	28th Ave S	TH 62	63000	12	44	53	50.97	-93	13	56.58	1	6	7	6
27526	44.9791139	-93.4005278	airmap	48	25	45	0	10	0	0	15	1966	US 169	Betty Crocker Dr	13000	17	44	58	44.81	-93	24	01.90	1	6	6	7
27530	44.8984139	-93.2155611	airmap	48	45	65	0	20	0	0	25	1966	TH 62	PED at 40th Ave S	1		44	53	54.29	-93	12	56.02	1	5	5	6
27531	44.9460639	-93.4005444	airmap	48	15	35	0	0	0	0	15	1967	Minnetonka Blvd	US 169	100000	12	44	56	45.83	-93	24	01.96	1	7	7	5
27535	44.8918639	-93.2550667	airmap	48	45	65	0	20	0	0	25	1967	TH 62	PED at 14th Ave	1		44	53	30.71	-93	15	18.24	1	5	5	5
27536	45.0075306	-93.4009167	airmap	48	45	65	0	20	0	0	25	1968	US 169	Medicine Lake Rd	4750	16	45	00	27.11	-93	24	03.30	1	6	5	5
27540	44.9929167	-93.4007806	airmap	48	25	45	0	0	0	0	25	1968	13th Ave N	US 169	89000	12	44	59	34.50	-93	24	02.81	1	5	6	6
27545	44.8928722	-93.4201667	airmap	48	25	45	0	10	0	0	15	1969	Shady Oak Rd	TH 62 WB	18500	12	44	53	34.34	-93	25	12.60	1	7	7	7
27546	44.8926556	-93.4201806	airmap	48	25	45	0	10	0	0	15	1969	Shady Oak Rd	TH 62 EB	18500	12	44	53	33.56	-93	25	12.65	1	6	7	7
27549A	45.0315222	-93.2874056	airmap	48	25	45	0	10	0	0	15	1975	I 94	42nd Ave N(Camden)	8100	16	45	01	53.48	-93	17	14.66	1	7	7	7
27555	45.0438944	-93.4008639	airmap	48	25	45	0	10	0	0	15	1973	US 169	49th Ave N	12800	17	45	02	38.02	-93	24	03.11	1	7	6	5
27583	44.9397556	-93.3970806	airmap	48	25	45	0	10	0	0	15	1983	US 169	W 36th St	7100	17	44	56	23.12	-93	23	49.49	1	7	7	5
27587	44.9279556	-93.3994	airmap	48	15	35	0	0	0	0	15	1980	2nd St NE	US 169	88000	12	44	55	40.64	-93	23	57.84	1	7	7	7
27589	44.8731833	-93.3966833	airmap	48	25	45	0	10	0	0	15	1976	US 169	Valley View Road	8100	16	44	52	23.46	-93	23	48.06	1	6	6	6
27630	45.0946472	-93.402375	airmap	48	35	55	0	10	0	0	25	1984	US 169	77th Ave N	15500	16	45	05	40.73	-93	24	08.55	1	6	6	5
27654	44.9834417	-93.4598694	airmap	48	35	55	0	10	0	0	25	1984	I 494	Carlson Pkwy	12500	17	44	59	0.39	-93	27	35.53	1	5	7	5
27655	44.9710194	-93.4697639	airmap	48	35	55	0	10	0	0	25	1986	US 12; COLLECTOR ROADS	CARLSON PKWY	11600	17	44	58	15.67	-93	28	11.15	1	5	6	5
27662	45.1410444	-93.39215	airmap	48	45	65	0	20	0	0	25	1984	US 169	PEDESTRIAN	1		45	08	27.76	-93	23	31.74	2	6	5	6
27679	44.9967222	-93.4581667	airmap	48	25	45	0	10	0	0	15	1989	I 494	CSAH 6	13500	16	44	59	48.20	-93	27	29.40	1	7	7	7
27681	45.0669333	-93.4477472	airmap	48	15	35	0	0	0	0	15	1992	I 494	Bass Lake Rd	21100	16	45	04	0.96	-93	26	51.89	1	7	7	7
27693	44.8081333	-93.3980778	airmap	48	15	35	0	0	0	0	15	1993	West 108th Street	US 169 NB	23500	14	44	48	29.28	-93	23	53.08	1	7	7	7
27694	44.8081083	-93.3984139	airmap	48	15	35	0	0	0	0	15	1993	West 108th Street	US 169 SB	23500	14	44	48	29.19	-93	23	54.29	1	7	7	7
27705	44.9802639	-93.27785	airmap	48	25	45	0	10	0	0	15	1989	I 394	7TH ST N	7900	16	44	58	48.95	-93	16	40.26	1	7	6	7
27707	45.0799333	-93.39215	airmap	48	25	45	0	10	0	0	15	1984	I 94; WB ON RAMP	BOONE AVE N	10500	16	45	04	47.76	-93	23	31.74	1	7	6	7
27709	44.8626194	-93.2376361	airmap	48	15	35	0	0	0	0	15	1989	I 494 WB OFF RAMP	24TH; WB OFF RAMP	24600	16	44	51	45.43	-93	14	15.49	1	7	6	6
27712	44.8618111	-93.2376806	airmap	48	15	35	0	0	0	0	15	1989	I 494 EB ON RAMP	24TH AVE; RAMP	24600	16	44	51	42.52	-93	14	15.65	1	7	6	6
27713	44.8605778	-93.4196028	airmap	48	15	35	0	0	0	0	15	1983	Prairie Center Drive	I 494 WB	31500	11	44	51	38.08	-93	25	10.57	1	7	7	7
27714	44.8603167	-93.4196917	airmap	48	15	35	0	0	0	0	15	1983	Prairie Center Drive	I 494 EB	31500	11	44	51	37.14	-93	25	10.89	1	7	7	7
27726	44.9795056	-93.2878167	airmap	48	35	55	0	10	0	0	25	1979	Glenwood Ave	I 94 EB off ramp	10900	11	44	58	46.22	-93	17	16.14	1	6	6	5
27727B	44.9794861	-93.2876194	airmap	48	25	45	0	10	0	0	15	1978	Glenwood Ave	I 94 SB on ramp	8000	11	44	58	46.15	-93	17	15.43	1	6	6	6
27730	44.9793333	-93.2789389	airmap	48	25	45	0	10	0	0	15	1988	I 394	TH 55 EB (10th ST)	9300	16	44	58	45.60	-93	16	44.18	1	6	7	7
27731	44.9705583	-93.4415861	airmap	48	25	45	0	10	0	0	15	1988	EB off ramp	I 394 EB on ramp	9000	11	44	58	14.01	-93	26	29.71	1	7	7	7
27734	45.0695167	-93.2890528	airmap	48	15	35	0	0	0	0	15	1980	I 94 WB	I 694 EB	49500	11	45	04	10.26	-93	17	20.59	1	6	6	6
27735	44.8263389	-93.2915889	airmap	48	25	45	0	0	0	0	25	1986	I 35W; SB ON RAMP	OLD SHAKOPEE RD	33500	16	44	49	34.82	-93	17	29.72	1	6	6	5
27736	44.970875	-93.4449694	airmap	48	15	35	0	0	0	0	15	1988	I 394; EB OFF RAMP	PLYMOUTH AVE	27100	16	44	58	15.15	-93	26	41.89	1	7	7	7
27737	44.9710278	-93.4206472	airmap	48	25	45	0	10	0	0	15	1988	I 394	HOPKINS CROSSROAD	6450	16	44	58	15.70	-93	25	14.33	1	7	7	7
27738	44.9730944	-93.4090056	airmap	24	25	45	0	10	0	0	15	1987	I 394	Shelard Pkwy	5000	19	44	58	23.14	-93	24	32.42	1	7	8	7
27740	44.9715778	-93.400575	airmap	24	15	35	0	0	0	0	15	1987	South Frontage Rd	US 169	100000	12	44	58	17.68	-93	24	2.07	1	7	8	7
27741	44.9715194	-93.400075	airmap	48	25	45	0	10	0	0	15	1987	SOUTH FRONTAGE RD	I 394 EB ON RAMP	8170	11	44	58	17.47	-93	24	0.27	1	7	7	7
27742	44.9733972	-93.4005806	airmap	48	15	35	0	0	0	0	15	1987	I 394; N-S COLLECTOR RD	US 169	100000	12	44	58	24.23	-93	24	02.09	1	6	6	6
27743	44.9741861	-93.3908833	airmap	48	15	35	0	0	0	0	15	1987	GENERAL MILLS BLVD.	I 394	132000	11	44	58	27.07	-93	23	27.18	1	7	7	7
27745	44.9714194	-93.3705889	airmap	48	25	45	0	10	0	0	15	1988	I 394	Louisiana Ave	11400	16	44	58	17.11	-93	22	14.12	1	7	7	5
27747	44.9704444	-93.3512417	airmap	48	25	45	0	10	0	0	15	1988	I 394; COLLECTOR RDS	PARK PLACE	16500	17	44	58	13.60	-93	21	04.47	1	7	6	7
27748	44.9687194	-93.3427278	airmap	48	25	45	0	10	0	0	15	1989	TH 100 SB	I 394 EB OFF RAMP	6000	11	44	58	7.39	-93	20	33.82	1	7	7	7
27749	44.9686278	-93.3417056	airmap	48	15	35	0	0	0	0	15	1989	South Frontage Road	TH 100	115000	12	44	58	07.06	-93	20	30.14	1	7	7	7
27750	44.9683889	-93.3409722	airmap	48	25	45	0	10	0	0	15	1989	NB TH 100	I 394 EB ON RAMP	6650	11	44	58	06.20	-93	20	27.50	1	7	7	7
27751A	44.9705	-93.3432611	airmap	48	25	45	0	10	0	0	15	1989	TH 100 SB	I 394R WB RAMP	7600	11	44	58	13.80	-93	20	35.74	1	7	6	7
27752	44.97065	-93.3408806	airmap	48	15	35	0	0	0	0	15	1989	I 394, I 394R	TH 100	90000	12	44	58	14.34	-93	20	27.17	1	7	6	7
27752A	44.9701917	-93.3413083	airmap	48	25	45	0	10	0	0	15	1989	I 394, I 394R	TH 100 SB ramp	5000	12	44	58	12.69	-93	20	28.71	1	7	6	6
27753	44.97055	-93.3371361	airmap	48	25	45	0	10	0	0	15	1989	I 394 EB	394R TO; FRM 100NB	7600	11	44	58	13.98	-93	20	13.69	1	7	6	7
27756	44.9702028	-93.3218222	airmap	48	25	45	0	10	0	0	15	1986	I 394, I 394R; FRONT RD	THEDORE WIRTH PKWY	11100	17	44	58	12.73	-93	19	18.56	1	6	6	7
27761	44.8686944	-93.4325333	airmap	48	25	45	0	10	0	0	15	1983	I 494	Valley View Road	17400	16	44	52	07.30	-93	25	57.12	1	5	6	7
27762	44.8626028	-93.4250111	airmap	48	25	45	0	0	0	0	25	1983	I 494	CSAH 61	31500	16	44	51	45.37	-93	25	30.04	1	5	6	5
27763	44.8628306	-93.2086861	airmap	48	35	55	0	10	0	0	25	1982	I 494; WB OFF RAMP	TH 5 EB ON RAMP	7500	11	44	51	46.19	-93	12	31.27	1	6	6	5
27765	44.8622194	-93.2230833	airmap	48	15	35	0	0	0	0	15	1983	34th Ave S	I 494	121000	11	44	51	43.99	-93	13	23.10	1	6	6	7
27766	44.8620139	-93.2146944	airmap	48	15	35	0	0	0	0	15	1983	I 494; TH 5 WB OFF RMAPS	TH 5 EB	33500	12	44	51	43.25	-93	12	52.9	1	6	6	6
27767	44.8624056	-93.2147889	airmap	48	15	35	0	0	0	0	15	1982	WB 494; 5 TO EB 494; 5	I 494	121000	11	44	51	44.66	-93	12	53.24	1	6	6	6
27769	44.8631056	-93.21455	airmap	48	25	45	0	10	0	0	15	1983	to 34th Avenue	I 494 WB off ramp	6000	11	44	51	47.18	-93	12	52.38	1	6	6	7
27770E	44.9694778	-93.3074639	airmap	48	25	45	0	10	0	0	15	1987	Penn Ave	I 394 EB on ramp	6700	11	44	58	10.12	-93	18	26.87	1	7	6	5
27770F	44.9702222	-93.3072167	airmap	48	35	55	0	10	0	0	25	1987	Penn Ave	I 394 WB off ramp	5000	11	44	58	12.8	-93	18	25.98	1	6	6	5
27776A	44.970275	-93.2993389	airmap	48	25	45	0	10	0	0	15	1987	I 394 WB, Dunwoody Blvd	I 394R	7600	11	44	58	12.99	-93	17	57.62	1	7	6	7
27776C	44.9741667	-93.2929833	airmap	48	35	55	0	20	0	0	15	1987	I 394 WB on ramp	I 394R WB	2175	11	44	58	27.00	-93	17	34.74	1	7	5	7
27781	44.9919694	-93.2849417	airmap	48	25	45	0	10	0	0	15	1980	I 94, RAMP; PLYMOUTH AVE	US 952A SB	12000	16	44	59	31.09	-93	17	05.79	1	6	7	6
27782	44.9876944	-93.2887806	airmap	48	25	45	0	10	0	0	15	1979	I 94	7th St	9400	16	44	59	15.70	-93	17	19.61	1	6	6	7
27785	44.9843167	-93.2880778	airmap	48	25	45	0	0	0	0	25	1979	I 94	TH 55	27500	14	44	59	03.54	-93	17	17.08	1	5	6	6
27787	44.9620472	-93.3441694	airmap	48	45	45	20	10	0	0	15	1989	BNSF RR; CITY STREETS	TH 100 E FRONTAGE	5000	12	44	57	43.37	-93	20	39.01	1	7	5	7
27788	44.9655389	-93.3428639	airmap	48	35	55	0	20	0	0	15	1989	TH 100 NB on ramp	I 394 EB on ramp	4500	11	44	57	55.94	-93	20	34.31	1	7	5	7
27789	44.9672528	-93.3428722	airmap	48	45	65	0	20	0	0	25	1989	SB CD R; FRNT RD	TH 100 SB CD	2000	12	44	58	02.11	-93	20	34.34	1	6	5	6
27789A	44.9669583	-93.3432167	airmap	48	25	45	0	10	0	0	15	1989	SB TH 100	I 394 EB off ramp	6000	11	44	58	01.05	-93	20	35.58	1	7	6	6
27791	44.9763917	-93.3434306	airmap	48	35	55	0	20	0	0	15	1989	TH 100 SB RAMP TO I 394	TH 100 SB ON RAMP	2000	12	44	58	35.01	-93	20	36.35	1	7	5	7
27792	44.9750833	-93.2866944	airmap	48	25	45	0	0	0	0	25	1968	I 94; RAMPS; STREETS	I 394	48000	11	44	58	30.3	-93	17	12.1	1	6	6	5
27793	44.9757806	-93.2874306	airmap	48	25	45	0	10	0	0	15	1968	I 94, RAMP; SB LYNDALE	I 94 NB OFF RAMP	18152	11	44	58	32.81	-93	17	14.75	1	6	7	5
27794	44.9742944	-93.2874333	airmap	48	25	45	0	10	0	0	15	1968	I 94, RAMPS; SB LYNDALE	I 394 EB OFF RAMP	6000	11	44	58	27.46	-93	17	14.76	1	7	7	5
27796	44.9919611	-93.2853306	airmap	48	35	55	0	10	0	0	25	1978	I 94, US 952A; RAMPS	PLYMOUTH AVE	9600	16	44	59	31.06	-93	17	07.19	1	5	6	5
27798	44.9758917	-93.2877778	airmap	48	25	45	0	10	0	0	15	1991	I 94, RAMP; LYNDALE	I 394 WB ON RAMPS	10000	11	44	58	33.21	-93	17	16	1	6	7	5
27799	44.9719278	-93.2874528	airmap	48	25	45	0	0	0	0	25	1968	Dunwoody Blvd	I 94	165000	11	44	58	18.94	-93	17	14.83	1	6	6	5
27799L	44.9724611	-93.2871556	airmap	48	25	45	0	10	0	0	15	1968	Lyndale Avenue NB	I 94 E Frontage Rd	10500	11	44	58	20.86	-93	17	13.76	1	7	6	6

27805	45.0670194	-93.2861556	airmap	48	15	35	0	0	0	0	15	1964	TH 252 SB	I 94 WB	26500	11	45	04	01.27	-93	17	10.16		1	7	7	7
27807	45.0511556	-93.2851556	airmap	48	25	45	0	10	0	0	15	1979	I 94	53rd Ave	6500	17	45	03	04.16	-93	17	06.56		1	6	6	7
27808	45.0439528	-93.2846528	airmap	48	25	45	0	10	0	0	15	1982	I 94, BUS RAMP; ON RAMP	49TH AVE N	5300	17	45	02	38.23	-93	17	04.75		1	6	7	7
27812	45.0239333	-93.2845167	airmap	48	15	35	0	0	0	0	15	1977	I 94	Dowling Ave	20900	17	45	01	26.16	-93	17	04.26		1	6	7	7
27813	45.0131111	-93.2825778	airmap	48	25	45	0	10	0	0	15	1977	I 94	Lowry Ave	10700	16	45	00	47.20	-93	16	57.28		1	6	7	7
27815	44.9991722	-93.2828528	airmap	48	15	35	0	0	0	0	15	1978	I 94; US 952A	BROADWAY AVE	20800	16	44	59	57.02	-93	16	58.27		1	6	7	7
27816N	44.9858944	-93.27935	airmap	48	55	55	20	10	0	0	25	1982	RR; STREETS TO I 94	US 952A NB	12000	16	44	59	09.22	-93	16	45.66		1	5	5	5
27817	44.9978417	-93.2835111	airmap	48	25	45	0	10	0	0	15	1980	SB off ramp	I 94 SB on ramp	6700	11	44	59	52.23	-93	17	0.64		1	6	7	6
27818	44.9962639	-93.2821972	airmap	48	25	45	0	10	0	0	15	1980	NB on ramp	I 94 NB off ramp	7000	11	44	59	46.55	-93	16	55.91		1	7	6	7
27820	44.8621972	-93.2376722	airmap	48	15	35	0	0	0	0	15	1989	I 494	CSAH 1	24600	16	44	51	43.91	-93	14	15.62		1	7	6	7
27829	44.9710389	-93.46025	airmap	48	15	35	0	0	0	0	15	1986	I 394; COLLECTOR RDS	I 494 NB	47000	11	44	58	15.74	-93	27	36.90		1	7	6	7
27830	44.9710833	-93.4606167	airmap	48	15	35	0	0	0	0	15	1986	I 394; COLLECTOR RDS	I 494 SB	47000	11	44	58	15.90	-93	27	38.22		1	7	7	5
27831	44.9726444	-93.2945028	airmap	48	50	70	0	0	0	25	25	1967	Dunwoody Blvd	I 394	147000	11	44	58	21.52	-93	17	40.21		1	6	5	5
27834	44.9654917	-93.2679361	airmap	48	15	35	0	0	0	0	15	1967	I 94 EB	I 35W	94000	11	44	57	55.77	-93	16	04.57		8	7	7	6
27838	44.9665639	-93.2765278	airmap	48	45	65	0	20	0	0	25	1965	I 94	1st Ave S	4900	17	44	57	59.63	-93	16	35.50		1	6	5	5
27840	44.9680333	-93.2696917	airmap	48	35	55	0	10	0	0	25	1966	TH 65; RAMPS	15TH ST E	5400	16	44	58	04.92	-93	16	10.89		1	6	6	5
27848	44.9661389	-93.2555861	airmap	48	25	45	0	0	0	0	25	1967	I 35W; SB on ramp	I 94 WB	66000	11	44	57	58.1	-93	15	20.11		1	6	6	5
27849	44.9676083	-93.2537833	airmap	48	35	55	0	10	0	0	25	1967	I 35W; RAMPS	TH 55 EB (8TH ST)	5400	14	44	58	03.39	-93	15	13.62		1	5	7	5
27850	44.9664194	-93.2548444	airmap	48	35	55	0	10	0	0	25	1967	I 35W; SB ON RAMP	I 94 WB ON RAMP	7300	11	44	57	59.11	-93	15	17.44		1	6	6	5
27852	44.9657139	-93.2650972	airmap	24	25	45	0	10	0	0	15	1967	I 35W, I 94; ramp	PARK AVE	11700	16	44	57	56.57	-93	15	54.35		1	8	8	5
27853	44.9656861	-93.2625667	airmap	48	25	45	0	10	0	0	15	1967	I 35W; I 94	CHICAGO AVE	6400	17	44	57	56.47	-93	15	45.24		1	8	6	5
27854	44.9658806	-93.2581778	airmap	48	35	55	0	10	0	0	25	1965	I 35W, I 94; WB ON RAMP	11 AVE	5900	17	44	57	57.17	-93	15	29.44		1	6	6	5
27857	44.9654667	-93.2516778	airmap	48	15	35	0	0	0	0	15	1967	I 94 WB ON RAMP	TH 55	62000	14	44	57	55.68	-93	15	6.04		8	7	7	6
27860	44.9669833	-93.2239083	airmap	48	25	45	0	10	0	0	15	1994	I 94; RAMPS	I 94 EB ON RAMP	6000	11	44	58	01.14	-93	13	26.07		1	7	6	6
27863	44.9657889	-93.2472611	airmap	48	15	35	0	0	0	0	15	1966	Cedar Ave	I 94	148000	11	44	57	56.84	-93	14	50.14		1	7	7	5
27865	44.9646389	-93.2441861	airmap	48	45	65	0	20	0	0	25	1966	I 94	20th Ave S	4700	16	44	57	52.70	-93	14	39.07		1	5	5	6
27873	44.9671361	-93.2540917	airmap	48	25	45	0	10	0	0	15	1970	I 35W; NB OFF RAMP	TH 55 SB OFF RAMP	8300	11	44	58	01.69	-93	15	14.73		1	6	7	7
27874	44.9677472	-93.2529361	airmap	48	25	45	0	10	0	0	15	1970	I 35W NB off ramp	TH 55 NB on ramp	6730	11	44	58	03.89	-93	15	10.57		1	6	6	7
27875	44.9681778	-93.2535389	airmap	48	35	55	0	10	0	0	25	1967	I 35W; RAMPS	TH 55 WB (7TH ST.)	7100	14	44	58	05.44	-93	15	12.74		1	5	6	5
27876	44.9698333	-93.2528444	airmap	48	25	45	0	10	0	0	15	1968	I 35W, RAMPS; COLL RDS	6TH STREET / EB 94	11970	11	44	58	11.40	-93	15	10.24		1	7	6	5
27877	44.9703333	-93.2526472	airmap	48	25	45	0	10	0	0	15	1969	I 35W; COLLECTOR RDS	5TH ST OFF 94 WB	9600	11	44	58	13.20	-93	15	09.53		1	7	6	6
27879	44.9721361	-93.2511444	airmap	48	15	35	0	0	0	0	15	1970	3rd street	I 35W	117000	11	44	58	19.69	-93	15	04.12		1	5	6	7
27879A	44.9722861	-93.2515944	airmap	48	25	45	0	10	0	0	15	1970	3rd Street	I 35W SB Coll Rd	10000	11	44	58	20.23	-93	15	05.74		1	5	6	7
27880	44.9718361	-93.2504	airmap	48	25	45	0	10	0	0	15	1970	U of M West Bank	I 35W NB Coll Rd	10700	11	44	58	18.61	-93	15	01.44		1	7	7	7
27881	44.9738889	-93.2495333	airmap	48	15	35	0	0	0	0	15	1967	I 35W	Washington Ave	24000	16	44	58	26.00	-93	14	58.32		1	7	7	7
27885	45.0006472	-93.2366417	airmap	48	35	55	0	10	0	0	25	1972	I 35W; NB OFF RAMP	JOHNSON ST NE	8500	16	45	0	2.33	-93	14	11.91		1	6	6	5
27886	44.9986944	-93.2378083	airmap	48	25	45	0	10	0	0	15	1972	I 35W; NB OFF RAMP	BROADWAY ST NE	19400	16	44	59	55.30	-93	14	16.11		1	6	6	6
27888	45.0014917	-93.2354889	airmap	48	15	35	0	0	0	0	15	1972	JOHNSON ST CONNECTION	I 35W NB	48500	16	45	0	5.37	-93	14	7.76		1	6	6	6
27890	45.0707722	-93.2868778	airmap	48	25	45	0	10	0	0	15	1988	TH 252 SB RAMP	I 694 WB OFF RAMP	5000	11	45	04	14.78	-93	17	12.76		9	6	7	7
27891	45.0694806	-93.286025	airmap	48	15	35	0	0	0	0	15	1980	TH 252; SB OFF RAMP	I 694	142000	11	45	4	10.13	-93	17	9.69		1	6	7	7
27892	44.858925	-93.3287806	airmap	48	15	35	0	0	0	0	15	1985	I 494	France Ave S	24500	16	44	51	32.13	-93	19	43.61		1	6	6	7
27895	45.0013167	-93.2269278	airmap	48	15	35	0	0	0	0	15	1971	Stinson Blvd	I 35W	97000	11	45	00	04.74	-93	13	36.94		1	6	6	6
27897	45.0041389	-93.2122722	airmap	48	25	45	0	0	0	0	25	1970	Industrial Blvd	I 35W	112000	11	45	00	14.90	-93	12	44.18		1	6	6	5
27899	45.0060361	-93.2078472	airmap	48	25	45	0	0	0	0	25	1970	MC RY	I 35W	108000	11	45	00	21.73	-93	12	28.25		1	5	6	6
27906	45.0915389	-93.4462139	airmap	48	25	45	0	10	0	0	15	1969	I 494 NB	94 WB TO SB I 494	16800	11	45	05	29.54	-93	26	46.37		1	6	7	7
27907	45.0916667	-93.4461361	airmap	48	15	35	0	0	0	0	15	1969	I 94 EB	TH 494 NB TO 94 WB	38000	11	45	05	30.00	-93	26	46.09		1	6	7	7
27910	45.0709917	-93.3071222	airmap	48	15	35	0	0	0	0	15	1979	I 94; I 694 EB	SHINGLE CREEK PKWY	21400	17	45	04	15.57	-93	18	25.64		1	7	6	7
27913	45.0693611	-93.3002389	airmap	48	35	55	0	10	0	0	25	1980	I 94, I694 EB; RAMPS	TH 100 SB ON RAMP	5250	12	45	04	09.7	-93	18	0.86		1	5	7	5
27914	45.0688667	-93.2996972	airmap	48	25	45	0	10	0	0	15	1980	I 94;694EB;TH100;RAMPS	TH 100 NB OFF RAMP	5250	17	45	04	07.92	-93	17	58.91		1	6	7	6
27925	45.0717944	-93.3095306	airmap	48	45	45	20	0	0	0	25	1964	Shingle Creek	I 94 WB	65500	11	45	04	18.46	-93	18	34.31		9	5	5	4
27945	45.1948556	-93.5524833	airmap	48	15	35	0	0	0	0	15	1969	I 94	TH 101	47000	12	45	11	41.48	-93	33	08.94		1	7	7	7
27946	45.1637694	-93.5214528	airmap	48	35	55	0	10	0	0	25	1969	I 94	Brockton Ln	5600	06	45	09	49.57	-93	31	17.23		1	6	6	5
27947	45.1722556	-93.526825	airmap	48	35	55	0	10	0	0	25	1969	I 94	CSAH 81	8300	06	45	10	20.12	-93	31	36.57		1	6	6	5
27957	44.9646222	-93.2158167	airmap	48	25	45	0	10	0	0	15	1965	I 94	Franklin Ave	6000	16	44	57	52.64	-93	12	56.94		1	7	6	5
27960	45.0693417	-93.3025556	airmap	48	25	45	0	10	0	0	15	1980	I 94 EB	I 694 EB on ramp	5200	11	45	04	09.63	-93	18	09.2		1	6	7	6
27961	44.9652833	-93.2888472	airmap	48	25	45	0	10	0	0	15	1969	LYNDALE; HENN AVE, RAMPS	I 94 WB OFF RAMP	10400	11	44	57	55.02	-93	17	19.85		1	7	7	6
27962	45.0692361	-93.2987167	airmap	48	25	45	0	0	0	0	25	1980	I 94, I 694 EB; RAMP	TH 100 SB	33000	12	45	04	09.25	-93	17	55.38		1	6	6	5
27963	44.9649528	-93.2885861	airmap	48	25	45	0	10	0	0	15	1965	LYNDALE; HENN AVE; RAMP	I 94 EB ON RAMP	12250	11	44	57	53.83	-93	17	18.91		1	7	6	5
27964	45.0741528	-93.3187333	airmap	48	25	45	0	10	0	0	15	1989	I 94	Xerxes Ave N	5100	17	45	04	26.95	-93	19	07.44		1	7	7	6
27965	44.9643194	-93.2883778	airmap	48	25	45	0	10	0	0	15	1965	LYNDALE AVE; RAMP	I 94 EB ON RAMP	10250	11	44	57	51.55	-93	17	18.16		1	7	6	6
27966	44.9647861	-93.2829778	airmap	48	35	55	0	20	0	0	15	1965	I 94	GROVELAND AVE	2700	17	44	57	53.23	-93	16	58.72		1	6	5	7
27971	45.0110028	-93.457275	airmap	48	15	35	0	0	0	0	15	1988	I 494	TH 55	59000	14	45	00	39.61	-93	27	26.19		1	6	7	6
27981	44.9668778	-93.2243583	airmap	48	25	45	0	10	0	0	15	1994	I 94	E River Road	5400	17	44	58	0.76	-93	13	27.69		1	7	6	6
27982	45.0688278	-93.2979806	airmap	48	15	35	0	0	0	0	15	1980	I 94 EB; EB ON RAMP	TH 100 NB	33000	12	45	04	07.78	-93	17	52.73		1	6	6	6
27983	44.863225	-93.2103806	airmap	48	15	35	0	0	0	0	15	1982	I 494 WB off ramp	TH 5 WB	33500	12	44	51	47.61	-93	12	37.37		1	6	6	7
27984	44.8628417	-93.2095028	airmap	48	15	35	0	0	0	0	15	1982	I 494; WB OFF RAMP	EB OVER TH494	33500	12	44	51	46.23	-93	12	34.21		1	6	7	5
27988	44.9868778	-93.2389222	airmap	48	35	55	0	10	0	0	25	1969	I 35W	8th St SE	12800	17	44	59	12.76	-93	14	20.12		1	6	6	5
27989	44.9915	-93.2364722	airmap	48	25	45	0	10	0	0	15	1969	I 35W	Hennepin Ave	19700	16	44	59	29.40	-93	14	11.30		1	6	6	6
27994	44.9924972	-93.2371972	airmap	48	25	45	0	10	0	0	15	1969	I 35W	SB Johnson St NE	5700	16	44	59	32.99	-93	14	13.91		1	6	7	5
27A98	45.1278528	-93.4857778	airmap	24	25	45	0	10	0	0	15	2006	I 94	Maple Grove Pkwy	18100	16	45	07	40.27	-93	29	08.80		1	7	8	8
27B65	44.9391583	-93.3565361	airmap	24	25	45	0	10	0	0	15	2009	TH 7	WOODDALE AVE	11300	17	44	56	20.97	-93	21	23.53		1	8	8	8
27B69	44.8989417	-93.4015056	airmap	24	25	45	0	10	0	0	15	2011	US 169	BREN RD W	19800	17	44	53	56.19	-93	24	05.42		1	8	8	7
27R02	44.8984361	-93.1998361	airmap	48	15	35	0	0	0	0	15	2000	TH 62; WB ON RMAP	TH 55	29500	12	44	53	54.37	-93	11	59.41		1	7	7	8
27R20	45.1088917	-93.3917917	airmap	48	15	35	0	0	0	0	15	2008	85 AVE N	US 169 SB	64900	12	45	06	32.01	-93	23	30.45		1	7	7	8
27R21	45.1089944	-93.391425	airmap	24	15	35	0	0	0	0	15	2008	85 AVE N	US 169 NB	64000	12	45	06	32.38	-93	23	29.13		1	8	8	8
27R25	44.8579111	-93.3940806	airmap	24	15	35	0	0	0	0	15	2011	WASHINGTON AV	USTH169	39000	12	44	51	28.48	-93	23	38.69		1	8	8	7
27R26	44.8579639	-93.3937917	airmap	24	15	35	0	0	0	0	15	2011	WASHINGTON AVE	US 169 NB	39000	12	44	51	28.67	-93	23	37.65		1	8	8	7
27R27	44.8612417	-93.3954083	airmap	24	15	35	0	0	0	0	15	2011	W 78TH ST	US 169 SB	24250	12	44	51	40.47	-93	23	43.47		1	7	8	7
27R28	44.8613917	-93.3951028	airmap	24	15	35	0	0	0	0	15	2011	W 78TH ST	US 169 NB	24250	12	44	51	41.01	-93	23	42.37		1	7	8	7
27V01	45.0831083	-93.4023222	airmap	48	15	35	0	0	0	0	15	1996	I 94	US 169 SB	39000	12	45	04	59.19	-93	24	08.36		1	7	7	7
27V02	45.0830083	-93.4020694	airmap	48	15	35	0	0	0	0	15	1996	I 94	US 169 NB	39000	12	45	04	58.83	-93	24	07.45		1	7	7	8
27V03	44.8595472	-93.3947139	airmap	48	15	35	0	0	0	0	15	1997	I 494	US 169 SB	28000	12	44	51	34.37	-93	23	40.97		1	7	7	7
27V04	44.8594639	-93.3943722	airmap	48	15	35	0	0	0	0	15	1997	I 494	US 169 NB	28000	12	44	51	34.07	-93	23	39.74		1	7	7	6
27V05	44.9407222	-93.45665	airmap	24	15	35	0	0	0	0	15	1998	Minnetonka Dr CSAH 5	I 494 SB	45000	11	44	56	26.60	-93	27	23.94		1	7	8	7
27V06	44.9405944	-93.4563667	airmap	48	15	35	0	0	0	0	15	1998	Minnetonka Dr CSAH 5	I 494 NB	45000	11	44	56	26.14	-93	27	22.92		1	7	7	7
27V09	44.8648306	-93.4299472	airmap	48	15	35	0	0	0	0	15	1999	US 212	I 494 SB	31500	11	44	51	53.39	-93	25	47.81		1	7	7	7
27V10	44.8648556	-93.4295583	airmap	48	15	35	0	0	0	0	15	1999	US 212	I 494 NB	31500	11	44	51	53.48	-93	25	46.41		1	7	7	6
27V11	44.8833833	-93.2958833	airmap	24	15	35	0	0	0	0	15	1999	W 66th St	I 35W	100000	11	44	53	0.18	-93	17	45.18		1	7	8	7
27V25	44.9666139	-93.2726889	airmap	48	25	45	0	10	0	0	15	2000	I 94; WB ON RAMP	3RD AVE S	7000	17	44	57	59.81	-93	16	21.68		1	7	7	7
27V33	44.8595472	-93.3621889	airmap	24	25	45	0	10	0	0	15	2003	I 494	E BUSH LAKE RD	12000	16	44	51	34.37	-93	21	43.88		1	7	8	6
27V38	44.8587889	-93.35015	airmap	48	15	35	0	0	0	0	15	2003	TH 100	I 494	130000	11	44	51	31.64	-93	21	0.54		1	7	7	7
27V39	45.0782667	-93.3762667	airmap	24	15	35	0	0	0	0	15	2001	W Broadway (CSAH 8)	I 94 WB	49000	11	45	4	41.76	-93	22	34.56		1	7	8	8
27V40	45.0781028	-93.3762583	airmap	24	15	35	0	0	0	0	15	2001	W Broadway (CSAH8)	I 94 EB	49000	11	45	4	41.17	-93	22	34.53		1	7	8	8
27V41	45.0897306	-93.4314194	airmap	48	15	35	0	0	0	0	15	2001	Hemlock Ln (CSAH 61)	I 94 WB	47000	11	45	05	23.03	-93	25	53.11		1	7	7	7
27V45	44.8620111	-93.3087778	airmap	48	15	35	0	0	0	0	15	2001	I 494	PENN AVE	20000	16	44	51	43.24	-93	18	31.60		1	7	7	6
27V46	45.0761833	-93.3556889	airmap	24	25	45	0	10	0	0	15	2002	I 94	ZANE AVE N	9800	16	45	04	34.26	-93	21	20.48		1	7	8	8
27V49	44.8913222	-93.4435278	airmap	24	15	35	0	0	0	0	15	2005	CSAH 62	I 494 SB	33500	11	44	53	28.76	-93	26	36.70		1	7	8	7
27V50	44.8913806	-93.4432611	airmap	48	15	35	0	0	0	0	15	2005	TH 62	I 494 NB	33500	11	44	53	28.97	-93	26	35.74		1	7	7	8
27V55	44.9042861	-93.4479444	airmap	24	15	35	0	0	0	0	15	2005	BAKER RD(CSAH 60)	I 494 SB	40500	11	44	54	15.43	-93	26	52.60		1	7	8	7
27V56	44.9046778	-93.4478667	airmap	24	15	35	0	0	0	0	15	2005	BAKER RD (CSAH 60)	I 494 NB	40500	11	44	54	16.84	-93	26	52.32		1	7	8	7
27V58	44.9143778	-93.4495917	airmap	24	25	45	0	10	0	0	15	2005	I 494	EXCELSIOR BLVD	10800	16	44	54	51.76	-93	26	58.53		1	7	8	7
27V59	44.9251222	-93.4515833	airmap	48	15	35	0	0	0	0	15	2005	I 494	TH 7 WB	22000	14	44	55	30.44	-93	27	05.70		1	7	7	7
27V60	44.9248472	-93.4515083	airmap	24	15	35	0	0	0	0	15	2005	I 494	TH 7 EB	22000	14	44	55	29.45	-93	27	05.43		1	7	8	8
27V62	44.9677667	-93.4603806	airmap	24	25	45	0	10	0	0	15	2005	I 494; RAMPS	OAKLAND RD	5000	19	44	58	03.96	-93	27	37.37		1	7	8	7
27V63	44.8618583	-93.2883833	airmap	48	15	35	0	0	0	0	15	2009	I 494	LYNDALE AVE S	21100	16	44	51	42.69	-93	17	18.18		1	7	7	5
27V71	44.8902583	-93.2883528	airmap	24	15	35	0	0	0	0	15	2007	LYNDALE AVE SO	I 35W	147000	11	44	53	24.93	-93	17	18.07		1	7	8	7
27V81	44.8942917	-93.2748556	airmap	24	15	35	0	0	0	0	15	2008	E 60 ST (MSAS 271)	I 35W	85000	11	44	53	39.45	-93	16	29.48		1	8	8	7
27V84	44.9035417	-93.2749111	airmap	24	25	45	0	10	0	0	15	2007	I 35W	E DIAMOND LAKE RD	12600	17	44	54	12.75	-93	16	29.68		1	7	8	7
27V85	44.8903972	-93.2780889	airmap	24	15	35	0	0	0	0	15	2008	NICOLLET AVE SO(CSAH 52)	I 35W SB	78000	11	44	53	25.43	-93	16	41.12		1	7	8	7
27V86	44.8901	-93.2780917	airmap	24	15	35	0	0	0	0	15	2008	NICOLLET AVE SO(CSAH 52)	I 35W NB	78000	11	44	53	24.36	-93	16	41.13		1	8	8	8
27V87	44.9124833	-93.2748194	airmap	24	25	45	0	10	0	0	15	2007	I 35W	E 50 ST	6100	17	44	54	44.94	-93	16	29.35		1	7	8	7
27V88	44.9196361	-93.2747417	airmap	24	25	45	0	10	0	0	15	2008	I 35W	E 46 ST (CSAH 46)	15600	16	44	55	10.69	-93	16	29.07		1	7	8	7
27V92	44.8614278	-93.3947222	airmap	24	15	35	0	0	0	0	15	2012	NE LOOP 169; 78TH ST	US 169 NB OFF RAMP	66000	11	44	51	41.14	-93	23	41.00		1	7	8	7
27V98	44.8655694	-93.2988056	airmap	24	15	35	0	0	0	0	15	2008	I 35W	W 76TH ST	23800	16	44	51	56.05	-93	17	55.70		1	8	8	7
27W03	44.9555444	-93.2703861	airmap	24	25	45	0	10	0	0	15	2018	I 35W	E 26TH ST	13300	16	44	57	19.96	-93	16	13.39		1	8	8	8
27W05	44.9592472	-93.2695694	airmap	24	15	35	0	0	0	0	15	2018	TH 65 NB	I 35W SB	48500	14	44	57	33.29	-93	16	10.45		1	8	8	8
27W06	44.9627111	-93.2694861	airmap	24	25	45	0	10	0	0	15	2018	I 35W; TH 65	CSAH 5	16600	16	44	57	45.76	-93	16	10.15		1	8	8	8
27W10	44.8819472	-93.4125889	airmap	24	25	45	0	10	0	0	15	2014	US 212	CSAH 61	12300	16	44	52	55.01	-93	24	45.32		1	8	8	8
27W25	45.0604056	-93.4503944	airmap	24	15	35	0	0	0	0	15	2015	HACKAMORE ROAD	I 494 SB	41500	11	45	03	37.46	-93	27	01.42		1	8	8	8
27W26	45.0603833	-93.4501278	airmap	24	15	35	0	0	0	0	15	2016	Hackamore Rd(Cty Rd 47)	I 494 NB	83000	11	45	03	37.38	-93	27	0.46		1	8	8	8
27W40	44.8479944	-93.2981861	airmap	24	25	45	0	10	0	0	15	2017	I 35W	W 86th St	6400	17	44	50	52.78	-93	17	53.47		1	8	8	8
4654	45.0568556	-92.8018722	airmap	48	55	55	20	10	0	0	25	1930	ST CROIX RIVER; PARK RD	MNTH 36	18000	14	45	03	24.68	-92	48	06.74	A	18	7	4	6
5199	44.9381417	-93.3626722	airmap	48	45	65	0	20	0	0	25	1934	TH 7	CP RAIL	1		44	56	17.31	-93	21	45.62		5	5	5	5
5310	44.9621306	-93.3444833	airmap	48	15	35	0	0	0	0	15	1936	BNSF, CEDAR LK; 23RD	TH 100	115000	12	44	57	43.67	-93	20	40.14		1	7	6	6
5983	44.8001972	-93.2899333	airmap	48	25	45	0	0	0	0	25	1957	MINN R; BLACKDOG RD	I 35W	106000	11	44	48	0.71	-93	17	23.76		1	5	6	6
62003	45.0527917	-93.1568361	airmap	48	45	65	0	20	0	0	25	1961	TH 51	CP RAIL	1		45	03	10.05	-93	09	24.61		6	6	5	6
62013	44.97095	-93.1670528	airmap	48	25	45	0	0	0	0	25	1965	Energy Park Dr (CSAH 32)	TH 51 (Snelling)	41000	16	44	58	15.42	-93	10	01.39		1	6	6	5

62014	44.9734389	-93.1670444	airmap	48	45	45	20	0	0	0	25	1965	BNSF RAIL; SERVICE RD	TH 51	42000	16	44	58	24.38	-93	10	01.36		1	6	5	6
62026	44.9317583	-93.0715472	airmap	48	35	35	20	0	0	0	15	1965	UP RR; EATON ST	LAFAYETTE (US 52)	74000	12	44	55	54.33	-93	04	17.57		1	7	5	6
62027	44.9397306	-93.0754778	airmap	48	15	35	0	0	0	0	15	1967	Plato Blvd (CSAH 40)	US 52 (Lafayette)	74000	12	44	56	23.03	-93	04	31.72		1	7	6	6
62029	45.0103417	-93.1765028	airmap	48	25	45	0	0	0	0	25	1969	Fairview Avenue	TH 36 WB	41000	12	45	00	37.23	-93	10	35.41		1	5	7	5
62030	45.0100278	-93.1764	airmap	48	25	45	0	0	0	0	25	1969	Fairview Avenue	TH 36 EB	41000	12	45	00	36.10	-93	10	35.04		1	6	6	5
62033	44.9646028	-93.2023472	airmap	48	25	45	0	10	0	0	15	1970	TH 280 SB	Franklin Ave	9100	16	44	57	52.57	-93	12	08.45		1	6	7	6
62034	44.9645917	-93.2020333	airmap	48	25	45	0	10	0	0	15	1970	TH 280 NB	Franklin Ave	9100	16	44	57	52.53	-93	12	07.32		1	6	7	5
62035	45.0102917	-93.1567	airmap	48	25	45	0	10	0	0	15	1969	TH 36	Hamline Ave North	12000	16	45	00	37.05	-93	09	24.12		1	7	7	5
62038	45.0502278	-93.1568083	airmap	24	25	45	0	10	0	0	15	2015	TH 51 (SNELLING AVE)	CO RD E (CSAH 15)	14200	16	45	03	0.82	-93	09	24.51		1	8	8	8
62045	44.9273611	-93.0697556	airmap	48	15	35	0	0	0	0	15	1972	Concord St (TH 156)	US 52 (Lafayette)	65000	12	44	55	38.50	-93	04	11.12		1	6	7	5
62048	44.9916917	-93.2051556	airmap	48	15	35	0	0	0	0	15	2009	TH 280	LARPENTEUR AVE	31100	16	44	59	30.09	-93	12	18.56		1	7	7	7
62051	45.0633556	-93.1582194	airmap	24	25	45	0	10	0	0	15	2012	I 694 WB	TH 51	19100	16	45	03	48.08	-93	09	29.59		1	8	8	7
62052	45.0615639	-93.1582917	airmap	24	15	35	0	0	0	0	15	2012	I 694; RAMP	TH 51	31500	16	45	03	41.63	-93	09	29.85		1	8	8	7
62057	45.0918361	-93.1881639	airmap	24	25	45	0	10	0	0	15	2012	I 35W; 35W SB OFF RAMP	US 810 WB	12000	16	45	05	30.61	-93	11	17.39		1	8	8	8
62058	45.0886222	-93.1879667	airmap	24	15	35	0	0	0	0	15	2012	I 35W; NB OFF RAMP	US 10 EB	23500	16	45	05	19.04	-93	11	16.68		1	8	8	8
62067	45.0117611	-93.0459056	airmap	24	25	45	0	10	0	0	15	2013	TH 36	ENGLISH STREET	6200	17	45	00	42.34	-93	02	45.26		1	8	8	8
62070	45.0117694	-93.0550167	airmap	48	25	45	0	0	0	0	25	1970	US 61	TH 36	59000	12	45	00	42.37	-93	03	18.06		1	5	6	5
62071	45.07925	-93.1766139	airmap	24	15	35	0	0	0	0	15	2013	CSAH 96	US10 EB	23500	16	45	04	45.30	-93	10	35.81		1	8	8	7
62072	45.0792361	-93.176225	airmap	24	15	35	0	0	0	0	15	2013	CSAH 96	US 10 WB	23500	16	45	04	45.25	-93	10	34.41		1	8	8	8
62073	45.0096806	-93.1261972	airmap	24	15	35	0	0	0	0	15	1999	Dale St N CSAH 53	TH 36 WB	40000	12	45	00	34.85	-93	07	34.31		1	7	8	7
62074	45.0095139	-93.1262056	airmap	24	15	35	0	0	0	0	15	1999	Dale St N CSAH 53	TH 36 EB	40000	12	45	00	34.25	-93	07	34.34		1	7	8	7
62094	45.0122556	-93.0050417	airmap	24	15	35	0	0	0	0	15	2007	MCKNIGHT RD (CSAH 68)	MN 36 WB	47000	14	45	00	44.12	-93	00	18.15		1	8	8	8
62095	45.0120917	-93.0050806	airmap	24	15	35	0	0	0	0	15	2007	MCKNIGHT RD (CSAH 68)	MN 36 EB	47000	14	45	00	43.53	-93	00	18.29		1	8	8	8
62548	45.0147222	-93.1875611	airmap	48	25	45	0	10	0	0	15	1986	I 35W; W FRONTAGE RD	CO RD B2(CSAH 24)	7100	16	45	00	53.00	-93	11	15.22		1	6	6	6
62626	44.9771472	-93.0886472	airmap	24	15	35	0	0	0	0	15	2012	I 35E	MARYLAND AVE	28500	16	44	58	37.73	-93	05	19.13		1	7	8	8
62631	45.0076444	-93.1058972	airmap	24	25	45	0	10	0	0	15	2011	TH 36	RICE ST N	18100	16	45	00	27.52	-93	06	21.23		1	8	8	8
62633	45.0076111	-93.1048278	airmap	24	25	45	0	10	0	0	15	2011	TH 36	TH 36 EB ON RAMP	7210	12	45	00	27.40	-93	06	17.38		1	8	8	7
62646	44.9918583	-93.0892722	airmap	24	25	45	0	10	0	0	15	2014	I 35E	LARPENTEUR AV	13500	16	44	59	30.69	-93	05	21.38		1	8	8	8
62701	44.9537306	-93.0908056	airmap	48	25	45	0	10	0	0	15	1989	I 94 EB	I 35E SB off ramp	14500	11	44	57	13.43	-93	05	26.9		1	7	7	7
62703	44.9522694	-93.0865472	airmap	48	35	55	0	10	0	0	25	1987	I 94; EB OFF RAMP	EAST 7TH STREET	19000	16	44	57	08.17	-93	05	11.57		1	6	6	5
62704	44.9519389	-93.0852222	airmap	48	25	45	0	10	0	0	15	1990	94 EB and off ramp	94 WB off ramp	6000	11	44	57	06.98	-93	05	06.8		1	7	7	6
62704A	44.9516806	-93.0855639	airmap	48	25	45	0	10	0	0	15	1990	I 94 WB off ramp	I 94 EB on ramp	6000	11	44	57	06.05	-93	05	08.03		1	7	7	7
62705	44.9523889	-93.0854333	airmap	48	25	45	0	10	0	0	15	1990	I 94 WB	Off ramp to TH 52	5000	11	44	57	08.60	-93	05	07.56		1	7	7	7
62706	44.9522944	-93.0697944	airmap	48	15	35	0	0	0	0	15	1987	I 94	US 61(Mounds Blvd)	21000	16	44	57	08.26	-93	04	11.26		1	6	6	6
62707	44.952525	-93.0828722	airmap	48	25	45	0	10	0	0	15	1990	I 94EB	OFF RAMP TO SB 52	12200	11	44	57	09.09	-93	04	58.34		1	7	7	5
62716	45.0667806	-93.1697472	airmap	24	15	35	0	0	0	0	15	2013	CSAH 76	I 694 WB	39500	11	45	04	0.41	-93	10	11.09		1	8	8	7
62717	45.0664778	-93.1697222	airmap	24	15	35	0	0	0	0	15	2012	CSAH 76	I 694 EB	39500	11	45	03	59.32	-93	10	11.00		1	7	8	7
62719	45.0663611	-93.1661528	airmap	24	15	35	0	0	0	0	15	2013	US 10 SB	I 694 WB	39500	11	45	03	58.90	-93	09	58.15		1	8	8	6
62720	45.0660639	-93.1659694	airmap	24	15	35	0	0	0	0	15	2012	US 10 SB	I 694 EB	39500	11	45	03	57.83	-93	09	57.49		1	8	8	7
62731	45.0104722	-93.1465	airmap	48	15	35	0	0	0	0	15	2016	LEXINGTON AVE(CSAH 51)	TH 36	84000	14	45	00	37.70	-93	08	47.40		1	8	7	8
62732	45.0954222	-93.1882389	airmap	24	25	45	0	10	0	0	15	2016	I 35W	CNTY RD H	10000	16	45	05	43.52	-93	11	17.66		1	8	8	8
62734	45.0104722	-93.1465	airmap	48	15	35	0	0	0	0	15	2016	LEXINGTON AVE(CSAH 51)	TH 36	84000	14	45	00	37.70	-93	08	47.40		1	8	7	8
62803	44.9413389	-93.1121444	airmap	48	25	45	0	10	0	0	15	1985	I 35E	Ramsey-Grand Ave	14700	16	44	56	28.82	-93	06	43.72		1	5	6	7
62808	44.9603694	-93.2021111	airmap	48	25	45	0	0	0	0	25	1967	TH280 NB; SB OFF RAMP	I 94 WB	85500	11	44	57	37.33	-93	12	07.6		1	5	7	5
62810	44.9579389	-93.0906528	airmap	48	15	35	0	0	0	0	15	1989	UNIVERSITY AVENUE	I 35E NB	77000	11	44	57	28.58	-93	05	26.35		1	7	7	6
62810A	44.957925	-93.0905611	airmap	48	25	45	0	10	0	0	15	1989	University Avenue	I 35E NB on ramp	10000	11	44	57	28.53	-93	05	26.02		1	7	7	7
62812	44.9593194	-93.2001417	airmap	48	25	45	0	0	0	0	25	1967	TH 280 SB	I 94 WB	65500	11	44	57	33.55	-93	12	0.51		1	6	6	5
62813	44.9594194	-93.2001111	airmap	48	45	65	0	20	0	0	25	1965	I 94; EB ON RAMP	PELHAM BLVD	4350	17	44	57	33.91	-93	12	0.40		1	5	5	5
62817	44.9498333	-93.101875	airmap	48	15	35	0	0	0	0	15	1989	I 35E; SB ON RAMP	I 94 EB	68000	11	44	56	59.40	-93	06	06.75		1	7	7	7
62823	45.0561472	-93.1313944	airmap	48	25	45	0	10	0	0	15	1992	I 694	Victoria St	15100	16	45	03	22.13	-93	07	53.02		1	7	7	7
62824	45.0596194	-93.1471778	airmap	48	15	35	0	0	0	0	15	1986	I 694	LEXINGTON (CSAH51)	23200	16	45	03	34.63	-93	08	49.84		1	6	6	7
62825	45.0374667	-93.0177222	airmap	48	15	35	0	0	0	0	15	1969	WHITE BEAR AVE (CSAH 65)	I 694 WB	38000	11	45	02	14.88	-93	01	03.80		1	7	7	7
62826	45.0372111	-93.0177	airmap	48	15	35	0	0	0	0	15	1969	WHITE BEAR AVE (CSAH 65)	I 694 EB	38000	11	45	02	13.96	-93	01	03.72		1	7	7	7
62827	45.0343	-92.9848361	airmap	48	35	55	0	10	0	0	25	1969	I 694	TH 120	13000	16	45	02	03.48	-92	59	05.41		1	6	6	5
62828	45.0654167	-93.2022111	airmap	48	25	45	0	10	0	0	15	1989	I 694	Long Lk Rd(CSAH45)	14200	16	45	03	55.5	-93	12	07.96		1	7	7	5
62830	44.9545056	-93.0911639	airmap	48	25	45	0	10	0	0	15	1989	I 94 WB; WB OFF RAMP	I 35E SB OFF RAMP	10100	11	44	57	16.22	-93	05	28.19		1	7	7	7
62831	44.9543222	-93.0908194	airmap	48	25	45	0	10	0	0	15	1990	I 94 WB; WB OFF RAMP	I 94 EB ON RAMP	19350	11	44	57	15.56	-93	05	26.95		1	8	7	7
62834	45.0792778	-93.0528417	airmap	24	15	35	0	0	0	0	15	1966	I 35E	CSAH 96	34000	16	45	04	45.40	-93	03	10.23		1	7	8	7
62836	45.1239806	-93.0496833	airmap	48	25	45	0	10	0	0	15	1967	I 35E	Co Rd J (CSAH 60)	10800	16	45	07	26.33	-93	02	58.86		1	6	6	6
62837	45.0365778	-93.0051806	airmap	48	25	45	0	10	0	0	15	1969	I 694	McKnight Rd	7100	16	45	02	11.68	-93	00	18.65		1	7	7	7
62838	44.9527361	-93.0414278	airmap	48	25	45	0	0	0	0	25	1973	TH 61NB; THREE RAMPS	I 94	114000	11	44	57	09.85	-93	02	29.14		1	6	6	5
62844	44.9624111	-93.2018444	airmap	48	35	55	0	10	0	0	25	1967	NB ON RAMP; TH 280 SB	TH 280 NB	18750	12	44	57	44.68	-93	12	06.64		1	6	6	5
62847	44.9517694	-93.1767667	airmap	48	15	35	0	0	0	0	15	1967	Fairview Avenue	I 94	165000	11	44	57	06.37	-93	10	36.36		9	6	6	6
62851	45.0376444	-93.0421222	airmap	48	15	35	0	0	0	0	15	1969	TH61	I 694 WB	39500	11	45	2	15.52	-93	2	31.64		1	7	6	7
62852	45.0374139	-93.0422889	airmap	48	15	35	0	0	0	0	15	1969	TH61	I 694 EB	39500	11	45	02	14.69	-93	02	32.24		1	6	6	7
62853	45.0090444	-93.2021167	airmap	48	25	45	0	10	0	0	15	1970	TH 280 NB	I35W RMP TO TH36EB	10000	11	45	00	32.56	-93	12	07.62		1	6	6	6
62857	44.9545611	-93.0924222	airmap	48	15	35	0	0	0	0	15	1990	OFF RAMP WB; I 94 WB	I 35E SB	77000	11	44	57	16.42	-93	05	32.72		1	7	7	5
62858	44.9547306	-93.0915861	airmap	48	15	35	0	0	0	0	15	1989	5 RAMPS WB; TH94 WB	I 35E NB	72000	11	44	57	17.03	-93	05	29.71		1	7	7	6
62860	45.0078583	-93.2045278	airmap	48	15	35	0	0	0	0	15	1970	NB RAMP; TH280 SB	I 35W	112000	11	45	00	28.29	-93	12	16.30		1	6	6	6
62862	44.9521389	-93.049225	airmap	48	15	35	0	0	0	0	15	1973	JOHNSON PKWY	I 94	130000	11	44	57	07.7	-93	02	57.21		8	7	6	6
62864	44.9290667	-93.1435778	airmap	48	15	35	0	0	0	0	15	1971	Ayd Mill Rd	I 35E	74000	11	44	55	44.64	-93	08	36.88		1	7	7	7
62865	44.9306111	-93.1412917	airmap	48	15	35	0	0	0	0	15	1971	Jefferson Avenue	I 35E	73000	11	44	55	50.2	-93	08	28.65		1	6	7	7
62869	44.9523861	-93.0359333	airmap	48	35	55	0	20	0	0	15	1974	I 94 EB on ramp	PED at Hazelwood	1		44	57	08.59	-93	02	09.36		1	6	5	7
62870	44.9530417	-93.0422056	airmap	48	15	35	0	0	0	0	15	1973	US 61 SB on ramp	US 61 NB	20000	14	44	57	10.95	-93	02	31.94		1	5	7	7
62873	45.0574056	-93.1874944	airmap	24	25	45	0	10	0	0	15	2016	I 35W	CO RD E2 (CSAH 73)	10300	16	45	03	26.66	-93	11	14.98		1	8	8	8
62874	44.9535917	-93.0928694	airmap	48	25	45	0	10	0	0	15	1989	35E NB on ramp	I 35E NB on ramp	7000	11	44	57	12.93	-93	05	34.33		1	7	6	7
62875	44.9541028	-93.0795389	airmap	48	45	45	20	0	0	0	25	1989	BNSF RR; 5TH; 6TH CONN	I 94 WB	58000	11	44	57	14.77	-93	04	46.34		1	7	5	5
62876	44.9543	-93.0779111	airmap	48	45	45	20	0	0	0	25	1989	BNSF RR; 5TH;6TH CONN	I 94 EB	58000	11	44	57	15.48	-93	04	40.48		1	7	5	5
62876B	44.9545167	-93.0778417	airmap	48	45	45	20	10	0	0	15	1989	BNSF RR	I 94 EB off ramp	5750	11	44	57	16.26	-93	04	40.23		1	7	5	7
62878	44.950825	-93.1099556	airmap	48	35	55	0	10	0	0	25	1991	I 94; EB OFF RAMP	MARION ST (CSAH56)	16200	16	44	57	02.97	-93	06	35.84		1	6	6	5
62879	44.9508278	-93.1075361	airmap	48	25	45	0	10	0	0	15	1991	I 94; EB OFF; ON RAMPS	I 94 WB ON RAMP	7500	11	44	57	02.98	-93	06	27.13		1	7	6	7
62880	44.9505167	-93.1090917	airmap	48	25	45	0	10	0	0	15	1991	I94 EB off ramp	I 94 EB ON RAMP	7000	11	44	57	01.86	-93	06	32.73		1	7	7	7
62881	44.9529111	-93.0827556	airmap	24	15	35	0	0	0	0	15	1992	I 94;EB; WB OFF RAMP	US 52	81000	12	44	57	10.48	-93	04	57.92		1	8	8	7
62883	44.9473222	-93.1036	airmap	48	25	45	0	10	0	0	15	1988	I 35E; 94 EB OFF RAMP	6TH STREET	15000	11	44	56	50.36	-93	06	12.96		1	7	7	7
62884	44.9548667	-93.0926806	airmap	48	25	45	0	10	0	0	15	1990	I 94 WB off ramp to 12th	I 35E SB off ramp	10000	11	44	57	17.52	-93	05	33.65		1	7	6	7
62886	44.9466806	-93.1043056	airmap	48	15	35	0	0	0	0	15	1988	I 35E	Kellogg Blvd	32000	16	44	56	48.05	-93	06	15.5		1	6	6	7
62887	44.949075	-93.1064611	airmap	48	25	45	0	10	0	0	15	1988	I 94 CONNECTING RD	JOHN IRELAND BLVD	7700	17	44	56	56.67	-93	06	23.26		8	6	6	6
62888	44.9508778	-93.0994861	airmap	48	25	45	0	10	0	0	15	1989	I 35E; NB OFF RAMP	WABASHA ST	9500	16	44	57	03.16	-93	05	58.15		1	6	6	7
62891	44.9520306	-93.0971361	airmap	48	25	45	0	10	0	0	15	1990	I 35E	Minnesota St	6800	17	44	57	07.31	-93	05	49.69		1	6	6	7
62893	44.9533194	-93.0944556	airmap	48	25	45	0	10	0	0	15	1990	I 35E; SB OFF RAMPS	JACKSON ST	10900	16	44	57	11.95	-93	05	40.04		1	7	6	7
62894	44.9526333	-93.0959167	airmap	48	25	45	0	10	0	0	15	1989	I 35E	US 952A(Robert St)	10600	16	44	57	09.48	-93	05	45.30		1	7	6	7
62895	45.0503194	-93.0589972	airmap	48	15	35	0	0	0	0	15	1992	I 35E	Co Rd E (CSAH 15)	21500	16	45	03	01.15	-93	03	32.39		1	7	7	7
62900	44.8912111	-93.0068444	airmap	48	25	45	0	10	0	0	15	2002	US 61	BAILEY/MAXWELL CN	10000	16	44	53	28.36	-93	00	24.64		1	7	7	7
62905	45.0348722	-93.0869556	airmap	24	15	35	0	0	0	0	15	2006	I 35E	I 694 EB	47000	11	45	02	05.54	-93	05	13.04		1	7	8	7
62906	45.0365139	-93.0766528	airmap	24	25	45	0	10	0	0	15	2004	I 35 E	EDGERTON ST(CSAH58	6700	16	45	02	11.45	-93	04	35.95		1	7	8	7
62907	45.0374944	-93.0650333	airmap	48	15	35	0	0	0	0	15	2006	I 35E	I 694 WB	41500	11	45	02	14.98	-93	03	54.12		1	6	7	5
62908	45.0375639	-93.0608583	airmap	24	25	45	0	10	0	0	15	2006	I 694	I 35E SB OFF RAMP	9000	11	45	02	15.23	-93	03	39.09		1	7	8	6
62910	45.0391722	-93.0626889	airmap	24	25	45	0	10	0	0	15	2006	I 35E; I 694 WB ON RAMP	I 35E SB OFF RAMP	9000	11	45	02	21.02	-93	03	45.68		1	7	8	7
62911	45.0791472	-93.1854694	airmap	24	25	45	0	10	0	0	15	2015	I 35W	CO RD G (CSAH 96)	10800	16	45	04	44.93	-93	11	07.69		1	8	8	8
62915	44.8918333	-93.0074694	airmap	48	25	45	0	10	0	0	15	2002	Drain Pond Ramp TH 61 SB	Bailey/Maxwell Con	5000	14	44	53	30.60	-93	00	26.89		1	7	7	7
62918	44.9613028	-93.0903083	airmap	24	15	35	0	0	0	0	15	2014	E PENNSYLVANIA AV	I 35E NB	69500	11	44	57	40.69	-93	05	25.11		1	8	8	8
62919	44.9614333	-93.0908972	airmap	24	15	35	0	0	0	0	15	2015	E PENNSYLVANIA AVE	I 35E SB	69500	11	44	57	41.16	-93	05	27.23		1	8	8	8
62927	44.98455	-93.0889444	airmap	24	25	45	0	10	0	0	15	2014	I 35E	EAST ARLINGTON AVE	5200	17	44	59	04.38	-93	05	20.20		1	8	8	8
62928	44.9906722	-93.0891583	airmap	24	25	45	0	10	0	0	15	2014	I 35E	WHEELOCK PKWY	5600	17	44	59	26.42	-93	05	20.97		1	8	8	7
62929	44.9990389	-93.0896444	airmap	24	15	35	0	0	0	0	15	2015	ROSELAWN AVE	I 35E SB	31500	11	44	59	56.54	-93	05	22.72		1	8	8	8
62930	44.9990167	-93.0893861	airmap	24	15	35	0	0	0	0	15	2014	ROSELAWN AVE	I 35E NB	63000	11	44	59	56.46	-93	05	21.79		1	8	8	8
62931	45.006275	-93.0897528	airmap	24	15	35	0	0	0	0	15	2015	COUNTY ROAD B	I 35E SB	31500	11	45	00	22.59	-93	05	23.11		1	8	8	8
62932	45.0062611	-93.0895167	airmap	24	15	35	0	0	0	0	15	2014	COUNTY ROAD B	I 35E NB	63000	11	45	00	22.54	-93	05	22.26		1	8	8	8
62933	45.0106056	-93.0898139	airmap	24	15	35	0	0	0	0	15	2015	TH 36	I 35E SB	31500	11	45	00	38.18	-93	05	23.33		1	8	8	7
62934	45.01065	-93.0895389	airmap	24	15	35	0	0	0	0	15	2014	TH 36	I 35E NB	63000	11	45	00	38.34	-93	05	22.34		1	8	8	7
62937	45.0931167	-93.1878361	airmap	24	15	35	0	0	0	0	15	2016	I 35W NB	RAMP NB TH 10	47000	16	45	05	35.22	-93	11	16.21		1	8	8	8
6307	44.8089111	-93.1028139	airmap	48	45	65	0	20	0	0	25	1921	MN 3	CP RAIL	1		44	48	32.08	-93	06	10.13		1	5	5	5
6347	45.3213389	-92.7099528	airmap	48	55	55	20	10	0	0	25	1953	ST CROIX RIVER	TH 243 (Osceola)	6985	06	45	19	16.82	-92	42	35.83	E	4	4	5	6
6580	45.0449833	-93.1063083	airmap	48	25	45	0	10	0	0	15	1957	I 694	RICE ST(TH 49)	18600	16	45	02	41.94	-93	06	22.71		1	6	6	6
6581	45.0477333	-93.1110833	airmap	48	35	55	0	20	0	0	15	1959	I 694	CP RAIL	1		45	02	51.84	-93	06	39.90		6	7	5	7
6583	44.7821667	-93.288475	airmap	48	45	45	20	0	0	0	25	1959	UP RR, Cliff Rd (CSAH32)	I 35W	99000	11	44	46	55.80	-93	17	18.51		1	6	4	5
6693	45.0003278	-93.0641944	airmap	48	25	45	0	10	0	0	15	1951	CHANNEL	US 61	15100	16	45	00	01.18	-93	03	51.10		1	7	7	6
6745	44.9835361	-93.4036417	airmap	24	15	35	0	0	0	0	15	1951	BASSETT CRK	TH 55, EB-WB	38500	14	44	59	0.73	-93	24	13.11		13	N	N	N
6804	44.674225	-93.6263667	airmap	48	25	45	0	0	0	0	25	1955	TH 21	US 169	22500	02	44	40	27.21	-93	37	34.92		1	6	6	5
6805	44.9736778	-93.2022889	airmap	48	45	45	20	0	0	0	25	1960	ROBBINS, TRANSITWAY; RR	TH 280	58000	12	44	58	25.24	-93	12	08.24		1	6	5	5
6850	44.8619083	-93.2984	airmap	48	15	35	0	0	0	0	15	1956	I 35W	I 494 WB	83000	11	44	51	42.87	-93	17	54.24		1	7	6	5
6851	44.8617444	-93.2984167	airmap	48	15	35	0	0	0	0	15	1956	I 35W	I 494 EB	83000	11	44	51	42.28	-93	17	54.30		1	7	7	6
70003	44.7790028	-93.3780972	airmap	24	15	35	0	0	0	0	15	2012	TH 13	TH 101 EB	25000	14	44	46	44.41	-93	22	41.15		1	8	8	8
70004	44.7856111	-93.4008111	airmap	48	45	45	20	0	0	0	25	1990	UP RR	TH 901B WB	25000	14	44	47	08.20	-93	24	02.92		1	7	5	5
70007	44.7779972	-93.5597389	airmap	48	25	45	0	10	0	0	15	2014	US 169	CSAH 69	7400	16	44	46	40.79	-93	33	35.06		1	7	7	6
70009	44.7846417	-93.4008028	airmap	48	15	35	0	0	0	0	15	1991	County 101 TH 169R	TH 801B EB	22750	14	44	47	04.71	-93	24	02.89		1	7	7	7
70013	44.7764028	-93.5201944	airmap	48	35	55	0	20	0	0	15	1995	US 169	CR 79	3550	17	44	46	35.05	-93	31	12.70		1	7	5	7

70014	44.7780639	-93.5053722	airmap	48	15	35	0	0	0	0	15	1993	US 169	CSAH 17	24800	16	44	46	41.03	-93	30	19.34		1	7	7	7
70031	44.6125361	-93.7700889	airmap	24	25	45	0	10	0	0	15	2016	US 169	ENTERPRISE DR	5000	19	44	36	45.13	-93	46	12.32		1	8	8	8
70037	44.7811583	-93.4767694	airmap	48	15	35	0	0	0	0	15	1994	MSAS 131	US 169 NB	20500	14	44	46	52.17	-93	28	36.37		1	7	7	7
70038	44.7813833	-93.4769889	airmap	48	15	35	0	0	0	0	15	1994	MSAS 131	US 169 SB	20500	14	44	46	52.98	-93	28	37.16		1	7	7	7
70039	44.7819667	-93.4696056	airmap	48	15	35	0	0	0	0	15	1993	CSAH 83	US 169 NB	20250	14	44	46	55.08	-93	28	10.58		1	7	7	7
70040	44.7822139	-93.4696194	airmap	48	15	35	0	0	0	0	15	1993	CSAH 83	US 169 SB	20250	14	44	46	55.97	-93	28	10.63		1	7	7	5
70043	44.6226778	-93.749175	airmap	48	25	45	0	10	0	0	15	2005	US 169; RAMPS	TH 25 NB	5700	07	44	37	21.64	-93	44	57.03		1	7	6	6
70044	44.6228361	-93.7489611	airmap	48	25	45	0	10	0	0	15	2005	US 169; RAMPS	TH 25 SB	5700	07	44	37	22.21	-93	44	56.26		1	7	7	6
70518	44.7898417	-93.4081889	airmap	48	25	45	0	10	0	0	15	1993	CSAH 101	US 169 SB OFF RAMP	5000	14	44	47	23.43	-93	24	29.48		1	7	7	6
70519	44.7890889	-93.4064639	airmap	48	15	35	0	0	0	0	15	1993	TH 801B	US 169 NB	23500	14	44	47	20.72	-93	24	23.27		1	7	7	7
70520	44.789425	-93.4067167	airmap	48	15	35	0	0	0	0	15	1993	TH 801B	US 169 SB	23500	14	44	47	21.93	-93	24	24.18		1	7	7	7
70521	44.7879417	-93.4084694	airmap	48	25	45	0	10	0	0	15	1993	County 101 EB (Savage)	US 169 NB	17750	14	44	47	16.59	-93	24	30.49		1	7	7	7
70522	44.7880889	-93.4086306	airmap	48	25	45	0	10	0	0	15	1993	County 101EB (Savage)	US 169 SB	17750	14	44	47	17.12	-93	24	31.07		1	7	7	7
70525	44.7837611	-93.4211194	airmap	48	25	45	0	10	0	0	15	1994	TH 169R WB	US 169 EB	17750	14	44	47	01.54	-93	25	16.03		1	7	7	7
70526	44.7838833	-93.42195	airmap	48	25	45	0	10	0	0	15	1994	TH 169R WB	US 169 WB	17750	14	44	47	01.98	-93	25	19.02		1	7	7	7
70527	44.78595	-93.4133917	airmap	48	25	45	0	10	0	0	15	1994	CSAH 18	US 169 EB	17750	14	44	47	9.42	-93	24	48.21		1	7	7	7
70528	44.7862056	-93.4134056	airmap	48	25	45	0	10	0	0	15	1994	CSAH 18	US 169 WB	17750	14	44	47	10.34	-93	24	48.26		1	7	7	7
70529	44.7839083	-93.4129778	airmap	48	25	45	0	10	0	0	15	1994	TH 169R	CSAH 18 NB	11400	16	44	47	02.07	-93	24	46.72		1	7	7	6
70530	44.7837778	-93.4133306	airmap	48	25	45	0	10	0	0	15	1994	TH 169R	CSAH 18 SB	11400	16	44	47	01.60	-93	24	47.99		1	7	7	7
70801	44.5732194	-93.2983778	airmap	48	35	55	0	10	0	0	25	1963	I 35	CSAH 2	9000	06	44	34	23.59	-93	17	54.16		1	6	6	5
7263	44.8869417	-93.328975	airmap	48	25	45	0	0	0	0	25	1962	TH 62	France Avenue	26000	16	44	53	12.99	-93	19	44.31		1	6	6	5
7265	44.8868611	-93.3337083	airmap	48	15	35	0	0	0	0	15	1962	VALLEY VIEW RD	TH 62 EB	45000	12	44	53	12.70	-93	20	01.35		1	6	6	6
7268	44.890775	-93.3086694	airmap	48	25	45	0	10	0	0	15	1962	TH 62	Penn Ave (CSAH 32)	14700	16	44	53	26.79	-93	18	31.21		1	7	7	6
7269	44.8906944	-93.2678444	airmap	48	25	45	0	10	0	0	15	1963	TH 62	Portland Ave	16300	16	44	53	26.50	-93	16	04.24		1	8	6	6
82001	45.2889556	-92.9839556	airmap	48	15	35	0	0	0	0	15	1969	2nd St NW	US 8	21000	14	45	17	20.24	-92	59	02.24		1	6	6	6
82002	45.2889778	-92.9839778	airmap	48	15	35	0	0	0	0	15	1969	TH 61	US 8	21000	14	45	17	20.32	-92	59	02.32		1	6	6	6
82003	44.8152111	-92.9344861	airmap	48	25	45	0	10	0	0	15	1982	Jamaica Avenue	US 61 SB	11250	14	44	48	54.76	-92	56	04.15		1	7	7	6
82004	44.815375	-92.934325	airmap	48	25	45	0	10	0	0	15	1982	Jamaica Avenue	US 61 NB	11250	14	44	48	55.35	-92	56	03.57		1	7	6	7
82006	45.0361417	-92.8464278	airmap	48	15	35	0	0	0	0	15	1997	TH 36	TH 5	20800	16	45	02	10.11	-92	50	47.14		1	7	7	7
82019	44.8328167	-92.9645083	airmap	48	15	35	0	0	0	0	15	1982	US 61	CSAH 39 80th St	21500	16	44	49	58.14	-92	57	52.23		1	6	7	5
82024	45.0355083	-92.9505083	airmap	24	15	35	0	0	0	0	15	2013	HIILTON TR	TH 36 EB	22500	14	45	02	07.83	-92	57	01.83		1	8	8	8
82025	44.8506056	-92.9900139	airmap	24	25	45	0	10	0	0	15	2005	US 61	CSAH 22	10700	16	44	51	02.18	-92	59	24.05		1	7	8	7
82029	44.8716472	-92.9997944	airmap	24	25	45	0	10	0	0	15	2003	HASTINGS AVENUE	GLEN ROAD	9000	19	44	52	17.93	-92	59	59.26		1	7	8	7
82030	44.8714944	-93.0002833	airmap	24	25	45	0	10	0	0	15	2003	US 61	GLEN ROAD	5000	19	44	52	17.38	-93	0	1.02		1	6	8	7
82034B	44.8879972	-93.0056889	airmap	24	25	45	0	10	0	0	15	2003	RAMP TH 61 SB	I 494 WB ON RAMP	5000	11	44	53	16.79	-93	00	20.48		1	7	8	8
82034C	44.8876333	-93.0049583	airmap	24	25	45	0	10	0	0	15	2003	TH 61	RAMP TO I 494 WB	5000	11	44	53	15.48	-93	00	17.85		1	7	8	6
82035	44.8878583	-93.0029917	airmap	48	25	45	0	10	0	0	15	2003	TH 61 SB	I 494 WB RAMP	6000	11	44	53	16.29	-93	0	10.77		1	7	7	7
82036	44.8870722	-93.0048528	airmap	48	25	45	0	10	0	0	15	2003	TH 61 SB ON RAMP	I 494 WB OFF RAMP	6000	11	44	53	13.46	-93	00	17.47		1	7	7	7
82043	45.0356222	-92.7974556	airmap	24	25	45	0	10	0	0	15	2013	TH 36; RAMPS	CSAH 23	8100	17	45	02	08.24	-92	47	50.84		1	8	8	8
82511	44.9162111	-92.9795	airmap	48	25	45	0	10	0	0	15	1994	I 494	Lake Road	15000	16	44	54	58.36	-92	58	46.20		1	6	7	6
82518	44.9365056	-92.9606083	airmap	48	15	35	0	0	0	0	15	2003	I 494	TAMARACK RD	22000	16	44	56	11.42	-92	57	38.19		1	6	7	7
82527	45.2794444	-93.0033806	airmap	24	15	35	0	0	0	0	15	2011	I 35	W BROADWAY AVE	26000	16	45	16	46.00	-93	00	12.17		1	6	8	7
82803	44.9704972	-92.958725	airmap	48	25	45	0	10	0	0	15	1967	I 694	15th Street North	5900	17	44	58	13.79	-92	57	31.41		1	6	6	7
82804	44.9875861	-92.9605556	airmap	48	35	55	0	10	0	0	25	1967	I 694	CSAH 6	5400	17	44	59	15.31	-92	57	38.00		1	5	6	6
82807	44.9976694	-92.9594889	airmap	48	15	35	0	0	0	0	15	1967	TH 5	I 694 SB	33500	11	44	59	51.61	-92	57	34.16		1	8	7	6
82808	44.9975056	-92.9591917	airmap	48	15	35	0	0	0	0	15	1967	TH 5	I 694 NB	33500	11	44	59	51.02	-92	57	33.09		1	8	7	7
82810	45.0209889	-92.9592139	airmap	48	15	35	0	0	0	0	15	1967	50TH ST N	I 694 NB	33500	11	45	01	15.56	-92	57	33.17		1	6	7	7
82813	45.0297611	-92.9623194	airmap	48	15	35	0	0	0	0	15	1967	TH 36	I 694 SB	33500	11	45	01	47.14	-92	57	44.35		1	7	6	5
82814	45.0298889	-92.9619556	airmap	48	15	35	0	0	0	0	15	1967	TH 36	I 694 NB	33500	11	45	01	47.6	-92	57	43.04		1	7	6	7
82815	45.2888444	-93.0030139	airmap	48	35	55	0	10	0	0	25	1967	I 35	US 8 WB	10500	02	45	17	19.84	-93	00	10.85		6	5	6	6
82818	44.9632556	-92.9583444	airmap	48	25	45	0	10	0	0	15	1967	I 694	CSAH 10	16500	16	44	57	47.72	-92	57	30.04		1	6	7	7
82843	44.9486278	-92.9345167	airmap	48	25	45	0	10	0	0	15	1983	I 94	CSAH 13 SB	16200	16	44	56	55.06	-92	56	04.26		1	7	7	6
82844	44.9485944	-92.9031667	airmap	48	15	35	0	0	0	0	15	1983	I 94	CSAH 19	25400	16	44	56	54.94	-92	54	11.40		1	6	6	7
82846	44.9486778	-92.8624806	airmap	48	25	45	0	10	0	0	15	1983	I 94	TH 95	12200	06	44	56	55.24	-92	51	44.93		1	6	7	5
82849	44.9620639	-92.7733528	airmap	48	25	45	0	0	0	0	25	1982	TH 95	I 94 WB	38500	01	44	57	43.43	-92	46	24.07		1	6	6	5
82850	44.9617417	-92.7733389	airmap	48	25	45	0	0	0	0	25	1982	TH 95	I 94 EB	38500	01	44	57	42.27	-92	46	24.02		1	6	6	5
82852	44.9485806	-92.9342889	airmap	48	25	45	0	10	0	0	15	1983	I 94	CSAH 13 NB	16200	16	44	56	54.89	-92	56	03.44		1	6	7	6
82857	44.8841167	-93.0083917	airmap	24	15	35	0	0	0	0	15	2003	MAXWELL AVE	I 494 EB	43500	11	44	53	02.82	-93	00	30.21		1	7	8	7
82858	44.8843389	-93.0085139	airmap	48	15	35	0	0	0	0	15	2003	MAXWELL AVE	I 494 WB	43500	11	44	53	3.62	-93	0	30.65		1	7	7	7
82863	44.8873583	-93.0021528	airmap	48	15	35	0	0	0	0	15	2003	TH 61 NB ON RAMP	I 494 EB	43500	11	44	53	14.49	-93	00	07.75		1	8	7	7
82864	44.8874889	-93.0023417	airmap	24	15	35	0	0	0	0	15	2003	TH 61 NB ON RAMP	I 494 WB	43500	11	44	53	14.96	-93	00	08.43		1	7	8	8
82865	44.8885472	-93.0014417	airmap	24	25	45	0	10	0	0	15	2003	I 494	BAILEY ROAD	8800	16	44	53	18.77	-93	00	05.19		1	7	8	7
86013	45.2293389	-93.5524583	airmap	24	25	45	0	10	0	0	15	2006	TH 101	CSAH 36	7700	07	45	13	45.62	-93	33	08.85		1	7	8	7
86015	45.2636917	-93.5559917	airmap	24	15	35	0	0	0	0	15	2006	CSAH 42	TH 101 SB	23000	14	45	15	49.29	-93	33	21.57		1	8	8	8
86016	45.2637306	-93.5557222	airmap	24	15	35	0	0	0	0	15	2006	CSAH 42	TH 101 NB	23000	14	45	15	49.43	-93	33	20.6		1	8	8	8
86017	45.2815861	-93.56115	airmap	24	15	35	0	0	0	0	15	2007	CSAH 39	TH 101 SB	23000	14	45	16	53.71	-93	33	40.14		1	8	8	8
86018	45.2815333	-93.5608972	airmap	24	15	35	0	0	0	0	15	2007	CSAH 39	TH 101 NB	23000	14	45	16	53.52	-93	33	39.23		1	8	8	8
9012	45.01025	-93.1666333	airmap	48	35	55	0	10	0	0	25	1958	TH 36	TH 51 SB	19750	16	45	00	36.90	-93	09	59.88		1	5	6	6
90381	44.9297056	-93.0807583	airmap	48	25	45	0	10	0	0	15	1930	Robert Street (952A)	George St	8500	17	44	55	46.94	-93	04	50.73		8	6	6	6
9041	44.8407778	-93.2982778	airmap	48	25	45	0	10	0	0	15	1957	I 35W	W 90th St	13700	17	44	50	26.80	-93	17	53.80		1	7	6	5
9050	44.9875306	-93.2035528	airmap	48	15	35	0	0	0	0	15	1957	COMO AVE	TH 280	48000	12	44	59	15.11	-93	12	12.79		1	6	6	6
9053	44.83355	-93.2950056	airmap	48	25	45	0	10	0	0	15	1957	I 35W	W 94th St	11000	17	44	50	0.78	-93	17	42.02		1	8	6	6
9071	44.8051556	-92.9127583	airmap	48	25	45	0	10	0	0	15	1958	US 61	CSAH19-ChemoliteRd	7700	16	44	48	18.56	-92	54	45.93		1	7	6	7
9079	44.8621667	-93.2681583	airmap	48	25	45	0	10	0	0	15	1959	I 494	Portland Ave	13000	16	44	51	43.80	-93	16	05.37		1	6	6	6
9080	44.8621611	-93.2580111	airmap	48	25	45	0	10	0	0	15	1959	I 494	12th Ave S	12100	19	44	51	43.78	-93	15	28.84		1	7	6	5
9081	44.8621972	-93.2475056	airmap	48	15	35	0	0	0	0	15	1958	I 494	TH 77 SB	47500	12	44	51	43.91	-93	14	51.02		1	7	7	7
9082	44.8622472	-93.2473139	airmap	48	15	35	0	0	0	0	15	1958	I 494	TH 77 NB	47500	12	44	51	44.09	-93	14	50.33		1	8	7	7
9108	44.8020833	-93.0391611	airmap	48	45	45	20	0	0	0	25	1958	UP RR	US 52 NB	23000	14	44	48	07.50	-93	02	20.98		1	6	5	5
9110	44.765125	-93.033675	airmap	48	45	65	0	10	10	0	25	1958	US 52 NB	TH 55 EB	6350	06	44	45	54.45	-93	02	01.23		7	6	5	6
9122	44.9005694	-93.5623472	airmap	48	35	55	0	10	0	0	25	1960	TH 7, REC TRL; TROLLEY	MILL ST	9850	16	44	54	02.05	-93	33	44.45		1	5	6	6
9123	44.6599972	-93.6281806	airmap	48	55	55	20	10	0	0	25	1957	UP RR	TH 21	8500	06	44	39	35.99	-93	37	41.45		9	5	5	5
9124	44.657875	-93.6284028	airmap	48	55	55	20	10	0	0	25	1958	Sand Creek	TH 21	8500	06	44	39	28.35	-93	37	42.25		6	5	5	7
9143	44.9484944	-92.9858944	airmap	48	15	35	0	0	0	0	15	1962	TH 120	I 94 WB	36000	11	44	56	54.58	-92	59	09.22		1	7	7	7
9144	44.9483389	-92.985825	airmap	48	15	35	0	0	0	0	15	1962	TH 120	I 94 EB	36000	11	44	56	54.02	-92	59	08.97		1	7	7	7
9145	44.9503667	-93.0049278	airmap	48	15	35	0	0	0	0	15	1962	MCKNIGHT RD	I 94 WB	43500	11	44	57	01.32	-93	00	17.74		1	7	7	7
9146	44.9501583	-93.0049667	airmap	48	15	35	0	0	0	0	15	1963	MCKNIGHT RD	I 94 EB	22500	11	44	57	0.57	-93	00	17.88		1	7	7	7
9147	44.9515083	-93.0151583	airmap	48	25	45	0	10	0	0	15	1969	I 94	RUTH ST	11800	16	44	57	05.43	-93	00	54.57		1	7	7	6
9148	44.951325	-93.0252389	airmap	48	15	35	0	0	0	0	15	1969	I 94	White Bear Avenue	22500	16	44	57	04.77	-93	01	30.86		1	7	7	7
9153	44.8777278	-93.1940528	airmap	48	25	45	0	0	0	0	25	1959	Inbnd Outbnd Airport Rd	TH 5 WB	36000	12	44	52	39.82	-93	11	38.59		1	6	6	5
9195	44.8835111	-93.2469111	airmap	48	35	55	0	10	0	0	25	1958	TH 77	EB 66th St	10600	17	44	53	0.64	-93	14	48.88		1	5	6	5
9212	45.00945	-93.0951139	airmap	48	45	65	0	20	0	0	25	1960	TH 36	CP RAIL	1		45	00	34.02	-93	05	42.41		6	7	3	7
9213	44.8552167	-93.298125	airmap	48	25	45	0	10	0	0	15	1957	I 35W	W 82nd St	12200	17	44	51	18.78	-93	17	53.25		1	7	7	6
9258	45.0116833	-93.0216833	airmap	48	15	35	0	0	0	0	15	1959	White Bear Avenue	TH 36	47000	14	45	00	42.06	-93	01	18.06		1	7	7	6
9276	45.0103167	-93.1867	airmap	48	25	45	0	0	0	0	25	1963	Cleveland Avenue	TH 36 WB	36500	12	45	00	37.14	-93	11	12.12		1	6	6	5
9289	44.8619583	-93.2834028	airmap	48	45	65	0	20	0	0	25	1959	I 494	CP RAIL	1		44	51	43.05	-93	17	0.25		5	6	5	6
9306	44.8935222	-93.1900667	airmap	48	25	45	0	10	0	0	15	1958	BLOOMINGTON R	TH 55 WB on ramp	11000	12	44	53	36.68	-93	11	24.24		1	7	7	7
9353	45.0205417	-93.1894694	airmap	48	25	45	0	0	0	0	25	1963	CO RD C(CSAH 23)	I 35W SB	56000	11	45	01	13.95	-93	11	22.09		1	6	6	5
9354	45.0205778	-93.1891417	airmap	48	25	45	0	0	0	0	25	1963	CO RD C(CSAH 23)	I 35W NB	56000	11	45	01	14.08	-93	11	20.91		1	5	6	5
9357	45.0502917	-93.1886528	airmap	48	45	65	0	20	0	0	25	1963	I 35W	CP RAIL	1		45	03	01.05	-93	11	19.15		1	7	4	6
9377	44.9516667	-93.1670833	airmap	48	15	35	0	0	0	0	15	1962	I 94	SNELLING AVE(TH51)	43000	16	44	57	06.00	-93	10	01.50		1	7	7	6
9381	44.9517861	-93.1568222	airmap	48	25	45	0	10	0	0	15	1964	I 94	HAMLINE AVE	16100	17	44	57	06.43	-93	09	24.56		1	7	7	6
9383	44.9517861	-93.1466639	airmap	48	15	35	0	0	0	0	15	1961	I 94	LEXINGTON(CSAH 51)	30000	16	44	57	06.43	-93	08	47.99		1	6	6	7
9389	45.0666694	-93.1931694	airmap	48	25	45	0	10	0	0	15	1964	I 694	5TH AVE NW(CSAH77)	9800	16	45	04	0.01	-93	11	35.41		1	6	7	7
9400	44.9628194	-92.7616111	airmap	48	45	45	20	0	0	0	25	1971	ST CROIX RIVER STR; RR	I 94 WB	41000	01	44	57	46.15	-92	45	41.80		1	6	5	6
9409	44.8703639	-93.1984944	airmap	48	45	65	0	20	0	0	25	1959	TH 5	Post Road	4400	19	44	52	13.31	-93	11	54.58		1	6	5	5
9417	45.2327639	-93.23455	airmap	48	55	55	20	10	0	0	25	1958	COON CREEK	TH 65 NB	16250	14	45	13	57.95	-93	14	04.38		11	5	5	5
9420	44.9643222	-93.2361611	airmap	48	25	45	0	10	0	0	15	1962	I 94	25TH Ave S	9900	16	44	57	51.56	-93	14	10.18		1	6	6	6
9421	44.9643528	-93.2333833	airmap	48	35	55	0	10	0	0	25	1962	I 94	Riverside Ave	5700	16	44	57	51.67	-93	14	0.18		1	7	6	4
9431	44.8762389	-93.350525	airmap	48	15	35	0	0	0	0	15	1977	W 70th St	TH 100	66000	12	44	52	34.46	-93	21	01.89		1	6	7	7
9452	44.9562611	-93.1924361	airmap	48	15	35	0	0	0	0	15	1968	I 94	CRETIN AVE	22300	16	44	57	22.54	-93	11	32.77		1	6	6	7
9472	44.9656833	-93.2020333	airmap	48	35	55	0	10	0	0	25	1971	TH 280	UNIVERSITY AVE	18200	16	44	57	56.46	-93	12	07.32		1	6	6	5
9491	44.8983389	-93.1773222	airmap	48	25	45	0	10	0	0	15	1962	TH 5 EB Off Ramp	Edgcumbe Road NB	11500	16	44	53	54.02	-93	10	38.36		1	6	7	7
9500	44.8897889	-93.3501056	airmap	48	15	35	0	0	0	0	15	1960	TH 62	TH 100	97000	12	44	53	23.24	-93	21	0.38		1	6	7	6
9519	44.9340639	-93.1269	airmap	48	25	45	0	10	0	0	15	1967	I 35E	St Clair Avenue	8800	17	44	56	02.63	-93	07	36.84		1	6	6	7
9521	44.9314417	-93.1364222	airmap	48	15	35	0	0	0	0	15	1966	Victoria Street	I 35E	73000	11	44	55	53.19	-93	08	11.12		1	7	7	7
9531	44.9157056	-93.1444472	airmap	48	15	35	0	0	0	0	15	1965	I 35E	W 7TH ST (TH 5)	27000	16	44	54	56.54	-93	08	40.01		1	7	6	5
9534	44.9109278	-93.1438917	airmap	48	25	45	0	0	0	0	25	1963	SHEPARD ROAD	I 35E	77000	11	44	54	39.34	-93	08	38.01		1	5	6	6
9537	44.8838639	-93.138525	airmap	48	25	45	0	10	0	0	15	1966	I 35E	TH 110 WB	13750	14	44	53	01.91	-93	08	18.69		1	7	6	5
9538	44.8836667	-93.1386556	airmap	48	35	55	0	10	0	0	25	1966	I 35E	TH 110 EB	13750	14	44	53	01.20	-93	08	19.16		1	6	6	5
9569	45.0104389	-93.1902444	airmap	48	35	55	0	0	10	0	25	1964	I 35W	TH 36 WB	43500	12	45	00	37.58	-93	11	24.88		7	6	5	5
9588	45.0128556	-93.1872778	airmap	48	45	65	0	10	10	0	25	1964	I 35W NB	I 35W SB OFF RAMP	7250	11	45	00	46.28	-93	11	14.20		7	6	5	6
9592	45.0889389	-93.0524889	airmap	48	45	65	0	20	0	0	25	1966	I 35E	CP RAIL	1		45	05	20.18	-93	03	08.96		6	6	5	6
9600N	44.8272778	-93.2312972	airmap	48	35	55	0	0	10	0	25	1978	MINNESOTA R ; BLACK DOG	TH 77 NB	47000	12	44	49	38.2	-93	13	52.67	Z	24	6	5	6
9600S	44.8270806	-93.2317028	airmap	48	35	55	0	0	10	0	25	1978	MINNESOTA R ; BLACK DOG	TH 77 SB	47000	12	44	49	37.49	-93	13	54.13	Z	24	6	5	6
9601	45.0672333	-93.1860417	airmap	48	15	35	0	0	0	0	15	1963	I 35W	I 694 WB	54000	11	45	04	02.04	-93	11	09.75		1	7	6	7
9602	45.0669944	-93.1859972	airmap	48	15	35	0	0	0	0	15	1963	I 35W	I 694 EB	54000	11	45	04	01.18	-93	11	09.59		1	7	6	6
9603	45.10795	-93.1883528	airmap	48	15	35	0	0	0	0	15	1968	CO RD I(CSAH 3)	I 35W	130000	11	45	06	28.62	-93	11	18.07		1	6	6	6

9605	45.1157139	-93.1884833	airmap	48	15	35	0	0	0	0	15	1968	TH I-35W	US 10	78000	12	45	06	56.57	-93	11	18.54	1	6	6	6
9607	45.1283194	-93.1885389	airmap	48	25	45	0	10	0	0	15	1968	I 35W	I 35W SB ON RP	8500	11	45	07	41.95	-93	11	18.74	1	7	7	7
96093	44.9351667	-93.0297167	airmap	24	15	35	0	0	0	0	15	1986	BIKE PATH	US 61	39500	14	44	56	06.60	-93	01	46.98	13	N	N	N
9616	44.9268389	-93.2746361	airmap	48	25	45	0	10	0	0	15	1964	I 35W	East 42nd St	5500	16	44	55	36.62	-93	16	28.69	1	6	6	6
9619	44.9341306	-93.2746889	airmap	24	25	45	0	10	0	0	15	1961	I 35W	E 38th St	9900	17	44	56	02.87	-93	16	28.88	1	8	8	7
9620	44.9377361	-93.2746861	airmap	48	25	45	0	10	0	0	15	1965	I 35W	EB E 36th St	10000	17	44	56	15.85	-93	16	28.87	1	6	7	6
9621	44.939525	-93.2746944	airmap	48	25	45	0	10	0	0	15	1965	I 35W	WB E 35th St	17100	17	44	56	22.29	-93	16	28.9	1	7	6	5
9655	44.957825	-93.091125	airmap	48	15	35	0	0	0	0	15	1963	University Avenue	I 35E SB	77000	11	44	57	28.17	-93	05	28.05	1	6	6	7
9700	45.2049167	-93.3864833	airmap	48	45	45	20	0	0	0	25	1962	Rum River	US 10	66000	12	45	12	17.70	-93	23	11.34	1	4	5	4
9713	45.2049111	-93.3897639	airmap	48	25	45	0	0	0	0	25	1964	US 10	US 169	26000	14	45	12	17.68	-93	23	23.15	1	6	6	5
9715	45.2049111	-93.3853833	airmap	48	25	45	0	10	0	0	15	1963	US 10	CSAH 31	5800	19	45	12	17.68	-93	23	07.38	1	6	7	5
9716	45.2045278	-93.37825	airmap	48	25	45	0	0	0	0	25	1965	CSAH 7 7th Avenue	US 10	67000	12	45	12	16.30	-93	22	41.70	1	6	6	5
9717	45.2044139	-93.3733528	airmap	48	25	45	0	0	0	0	25	1965	BNSF; PRIVATE ROAD	US 10	67000	12	45	12	15.89	-93	22	24.07	1	6	6	5
9725	45.1359278	-93.270425	airmap	48	25	45	0	10	0	0	15	1966	CSAH 10	TH 47 SB	11000	16	45	08	09.34	-93	16	13.53	1	7	6	6
9726	45.1356778	-93.2701111	airmap	48	25	45	0	10	0	0	15	1966	CSAH 10	TH 47 NB	11000	16	45	08	08.44	-93	16	12.40	1	7	6	6
9775	44.9118	-92.9843833	airmap	48	15	35	0	0	0	0	15	1960	CSAH 25 (CENTURY AVE)	I 494 WB	32000	11	44	54	42.48	-92	59	03.78	1	7	6	6
9776	44.91125	-92.9843833	airmap	48	15	35	0	0	0	0	15	1960	CSAH 25 (CENTURY AVE)	I 494 EB	32000	11	44	54	40.50	-92	59	03.78	1	6	7	7
9779	44.7753222	-93.2883694	airmap	48	35	55	0	10	0	0	25	1959	I 35W	TH 13 SB	18000	14	44	46	31.16	-93	17	18.13	1	6	6	5
9805	44.9506222	-93.1018444	airmap	48	45	65	0	10	10	0	25	1966	12TH STREET EAST	I 94 WB ON RAMP	9400	11	44	57	02.24	-93	06	06.64	7	5	5	4
9805A	44.9504889	-93.1017611	airmap	48	45	65	0	10	10	0	25	1966	I 94 WB	RAMP TO I 35E SB	9400	11	44	57	01.76	-93	06	06.34	7	6	5	4
9830	45.19275	-93.0729	airmap	48	25	45	0	10	0	0	15	1967	I 35W	CSAH 14	6400	14	45	11	33.90	-93	04	22.44	1	6	7	5
9831	45.1681222	-93.1428972	airmap	48	25	45	0	10	0	0	15	1967	I 35W	CR 53	5000	17	45	10	05.24	-93	08	34.43	1	6	7	6
9860	45.0687139	-93.2681278	airmap	48	15	35	0	0	0	0	15	1964	I 694	MAIN ST NE	27000	16	45	04	07.37	-93	16	05.26	1	6	6	7
9869	45.0644861	-93.2184306	airmap	48	25	45	0	0	0	0	25	1964	I 694	Silver Lk Rd	22700	16	45	03	52.15	-93	13	06.35	1	6	6	5
9881	44.901825	-92.9944444	airmap	48	15	35	0	0	0	0	15	1960	CSAH 43 (CARVER AVE)	I 494 WB	32000	11	44	54	06.57	-92	59	40.00	1	6	6	6
9882	44.9017417	-92.9941556	airmap	48	15	35	0	0	0	0	15	1960	CSAH 43 (CARVER AVE)	I 494 EB	32000	11	44	54	06.27	-92	59	38.96	1	6	6	6
9893	44.9647861	-93.2288972	airmap	48	45	45	20	0	0	0	25	1962	Franklin Terrace	I 94	167000	11	44	57	53.23	-93	13	44.03	9	5	5	6
02033	45.1522472	-93.274475	airmap	48	25	45	0	0	0	0	25	1996	US 10, RAMP; MN 47	FOLEY BLVD	20100	16	45	09	08.09	-93	16	28.11	1	7	4	6
02813	45.0687444	-93.2633361	airmap	48	15	35	0	0	0	0	15	1988	MN 47	I 694	123000	11	45	04	07.48	-93	15	48.01	1	7	5	6
10029	44.8058556	-93.625375	airmap	48	25	45	0	10	0	0	15	2007	US 212	ENGLER BLVD	8800	16	44	48	21.08	-93	37	31.35	1	8	5	8
19056	44.8148556	-93.2213083	airmap	48	35	55	0	10	0	0	25	1978	NB TH 77	TH 13 NB	12500	16	44	48	53.48	-93	13	16.71	1	6	5	5
19853	44.8751639	-93.0756528	airmap	48	35	55	0	10	0	0	25	1985	I 494, WB ON RAMP	TH 110 EB	10750	16	44	52	30.59	-93	04	32.35	1	6	5	5
19855	44.87465	-93.0608556	airmap	48	25	45	0	0	0	0	25	1984	I 494, COLL ROADS	US 52 SB	30000	12	44	52	28.74	-93	03	39.08	1	6	5	5
19856	44.8747667	-93.0605611	airmap	48	25	45	0	0	0	0	25	1984	I 494, COLL ROADS	US 52 NB	30000	12	44	52	29.16	-93	03	38.02	1	6	5	5
19863	44.7699194	-93.2885972	airmap	48	35	55	0	10	0	0	25	1969	I 35W	Burnsville Parkway	16400	16	44	46	11.71	-93	17	18.95	1	5	4	5
19865	44.8761333	-93.0307306	airmap	48	25	45	0	0	0	0	25	1980	TH 156 (CONCORD STREET)	I 494	85000	11	44	52	34.08	-93	01	50.63	1	5	5	4
19894	44.8745333	-93.0424583	airmap	48	35	55	0	10	0	0	25	1983	I 494	7th Avenue South	11000	16	44	52	28.32	-93	02	32.85	1	6	5	5
19895	44.8744472	-93.039925	airmap	48	35	55	0	10	0	0	25	1983	I 494	5th Avenue South.	8600	19	44	52	28.01	-93	02	23.73	1	6	5	5
27038	45.0509639	-93.3221972	airmap	48	15	35	0	0	0	0	15	1963	TH 100	Brooklyn Blvd	22300	16	45	03	03.47	-93	19	19.91	1	7	5	7
27161	44.8916333	-93.1880861	airmap	48	35	55	0	10	0	0	25	1968	TH 5 WB ON RAMP	TH 55 EB OFF RAMP	11000	12	44	53	29.88	-93	11	17.11	1	5	5	5
27238	45.1305861	-93.4393333	airmap	48	25	45	0	10	0	0	15	2005	TH 610; ON RAMP	CSAH 81	15400	16	45	07	50.11	-93	26	21.6	1	7	5	7
27517	44.9544917	-93.4007861	airmap	48	35	55	0	10	0	0	25	1964	US 169	Cedar Lake Rd	14700	16	44	57	16.17	-93	24	02.83	1	5	5	5
27522	44.89755	-93.2229694	airmap	48	35	55	0	10	0	0	25	1964	TH 62	34th Ave S	6300	19	44	53	51.18	-93	13	22.69	1	6	5	5
27523	45.0580306	-93.4008778	airmap	48	25	45	0	0	0	0	25	1971	US 169	Bass Lake Road	26100	16	45	03	28.91	-93	24	03.16	1	6	5	5
27534	45.0693778	-93.4010917	airmap	48	35	55	0	10	0	0	25	1968	US 169	63rd Ave N	7400	16	45	04	09.76	-93	24	03.93	1	5	5	5
27550	45.0220417	-93.4007806	airmap	48	35	55	0	10	0	0	25	1969	US 169	36th Ave S	15200	17	45	01	19.35	-93	24	02.81	1	5	5	5
27551	45.033325	-93.4008111	airmap	48	25	45	0	0	0	0	25	1972	US 169	Rockford Rd	24600	16	45	01	59.97	-93	24	02.92	1	5	5	4
27758	44.9700167	-93.3088611	airmap	48	35	55	0	10	0	0	25	1986	I 394; I 394R	PENN AVE S	10300	16	44	58	12.06	-93	18	31.90	1	5	5	5
27799R	44.9726361	-93.2878111	airmap	48	25	45	0	0	0	0	25	1969	Lyndale Avenue SB	I 94 EB on ramp	25400	11	44	58	21.49	-93	17	16.12	1	6	5	6
27836	44.9658	-93.2793417	airmap	48	35	55	0	10	0	0	25	1964	I 94	LASALLE AVE	7100	17	44	57	56.88	-93	16	45.63	1	7	5	5
27837	44.96625	-93.2778167	airmap	48	35	55	0	10	0	0	25	1966	I 94	Nicollet Ave	8600	16	44	57	58.50	-93	16	40.14	1	5	5	5
27851	44.9657417	-93.2676556	airmap	48	35	55	0	10	0	0	25	1967	I 35W; I 94 WB	PORTLAND AVE	13300	16	44	57	56.67	-93	16	03.56	1	7	5	5
27855	44.9660944	-93.2522861	airmap	48	25	45	0	0	0	0	25	1967	TH 55; RAMPS	I 94	132000	11	44	57	57.94	-93	15	08.23	1	6	5	5
27882	44.9823083	-93.2435	airmap	48	25	45	0	0	0	0	25	1967	I 35W	UNIVERSITY AVE	22300	16	44	58	56.31	-93	14	36.60	10	5	5	7
27883	44.9832639	-93.2427056	airmap	48	35	55	0	10	0	0	25	1967	I 35W	4TH ST SE	19100	16	44	58	59.75	-93	14	33.74	10	4	5	7
27887	45.0020778	-93.2355722	airmap	48	25	45	0	0	0	0	25	1972	JOHNSON ST CONNECTION	I 35W SB	48500	11	45	0	7.48	-93	14	8.06	1	6	5	6
27950	45.1045139	-93.4599444	airmap	48	25	45	0	0	0	0	25	1969	I 94	Weaver Lake Rd	38900	16	45	06	16.25	-93	27	35.80	1	6	5	5
27972	45.0284778	-93.4526056	airmap	48	25	45	0	0	0	0	25	1965	I 494	Rockford Road	23500	16	45	01	42.52	-93	27	09.38	1	5	5	5
27A69	45.1245917	-93.4838417	airmap	48	25	45	0	10	0	0	15	2001	I 94; RAMP	CSAH 30	19600	16	45	07	28.53	-93	29	01.83	1	7	5	7
27V42	45.0895111	-93.4314278	airmap	48	15	35	0	0	0	0	15	2001	HEMLOCK LN (CSAH 61)	I 94 EB	47000	11	45	05	22.24	-93	25	53.14	1	7	5	7
62011	44.9694028	-93.1670528	airmap	48	25	45	0	0	0	0	25	1965	Pierce Butler Route	TH 51 (Snelling)	41000	16	44	58	09.85	-93	10	01.39	1	7	5	5
62015	44.9773472	-93.1670611	airmap	48	25	45	0	0	0	0	25	1965	Como Avenue (CSAH 75)	TH 51 (Snelling)	36000	16	44	58	38.45	-93	10	01.42	1	6	5	5
62040	45.0134556	-93.1669778	airmap	48	25	45	0	0	0	0	25	1969	CO RD B2 (CSAH 78)	TH 51 (Snelling)	40000	16	45	00	48.44	-93	10	01.12	1	6	5	6
62876A	44.9536167	-93.0798111	airmap	48	35	55	0	10	0	0	25	1989	5th; 6TH ST CONN	I 94 EB ON RAMP	6000	11	44	57	13.02	-93	4	47.32	1	7	5	5
62877	44.9512167	-93.1161194	airmap	48	25	45	0	10	0	0	15	1991	I 94	WESTERN AVE	7000	17	44	57	04.38	-93	06	58.03	1	7	5	7
62882	44.9552639	-93.07535	airmap	48	35	55	0	10	0	0	25	1989	I 94 WB	I 94 EB OFF RAMP	5750	11	44	57	18.95	-93	04	31.26	1	6	4	5
62896	45.0229	-93.0897306	airmap	48	25	45	0	10	0	0	15	1987	I 35E	Little Canada Rd	13700	16	45	01	22.44	-93	05	23.03	1	6	5	7
62897	44.9504667	-93.1007528	airmap	48	35	55	0	10	0	0	25	1989	I 35E, I 94; RAMPS	ST PETER S	6500	16	44	57	01.68	-93	06	02.71	1	6	5	6
7264	44.8871111	-93.3337472	airmap	48	25	45	0	0	0	0	25	1961	VALLEY VIEW RD	TH 62 WB	45000	12	44	53	13.60	-93	20	01.49	1	6	5	5
82831	44.9487111	-92.9591056	airmap	48	25	45	0	0	0	0	25	1966	I 94; COLLECTOR ROADS	I 694 SB	36500	11	44	56	55.36	-92	57	32.78	1	4	5	6
82832	44.9486833	-92.9587389	airmap	48	25	45	0	0	0	0	25	1966	I 94; COLLECTOR ROADS	I 694 NB	36500	11	44	56	55.26	-92	57	31.46	1	4	5	6
9013	45.0101611	-93.1663806	airmap	48	35	55	0	10	0	0	25	1958	TH 36	TH 51 NB	19750	16	45	00	36.58	-93	09	58.97	1	5	5	5
9043	44.8118556	-93.2915194	airmap	48	25	45	0	0	0	0	25	1957	106TH ST W	I 35W SB	51000	11	44	48	42.68	-93	17	29.47	1	6	4	6
9044	44.8118139	-93.2913972	airmap	48	25	45	0	0	0	0	25	1957	106TH ST W	I 35W NB	51000	11	44	48	42.53	-93	17	29.03	1	6	4	5
9077	44.8617333	-93.2782972	airmap	48	25	45	0	10	0	0	15	1959	I 494	Nicollet Ave	12800	16	44	51	42.24	-93	16	41.87	1	6	5	7
9154	44.8778417	-93.1942361	airmap	48	35	55	0	10	0	0	25	1959	Outbnd Airport Rd	Inbnd Airport Rd	15500	12	44	52	40.23	-93	11	39.25	1	7	5	5
9263	45.1207694	-93.2375639	airmap	48	25	45	0	0	0	0	25	1960	TH 65	CSAH 10 WB	40000	16	45	7	14.77	-93	14	15.23	1	6	5	6
9264	45.1205833	-93.2376722	airmap	48	25	45	0	0	0	0	25	1960	TH 65	CSAH 10 EB	40000	16	45	7	14.10	-93	14	15.62	1	6	5	5
9277	45.0100389	-93.1867306	airmap	48	25	45	0	0	0	0	25	1963	Cleveland Avenue	TH 36 EB	36500	12	45	00	36.14	-93	11	12.23	1	6	5	5
9355	45.0356306	-93.1904972	airmap	48	35	55	0	10	0	0	25	1963	I 35W	CO RD D(CSAH 19)	15900	16	45	02	08.27	-93	11	25.79	1	6	5	6
9457	44.9544528	-93.1873639	airmap	48	25	45	0	10	0	0	15	1966	I 94	CLEVELAND AVE	6700	16	44	57	16.03	-93	11	14.51	1	7	5	6
9528	44.9268694	-93.1447833	airmap	48	25	45	0	0	0	0	25	1967	I 35E; I35E OFF RAMP	CSAH 38	25000	16	44	55	36.73	-93	08	41.22	1	6	5	5
9780	44.7751083	-93.288375	airmap	48	35	55	0	10	0	0	25	1959	I 35W	TH 13 NB	18000	14	44	46	30.39	-93	17	18.15	1	6	5	5