REMOTE OBSERVATION OVER TIME (DRONE IN A BOX)- PHASE 1

Task 4 Report- Staged Field Testing of DiaB System

Prepared by
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Prepared for the
MONTANA DEPARTMENT OF TRANSPORTATION
in cooperation with the
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FEDERAL HIGHWAY ADMINISTRATION
Helena, MT 59620-1001

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Disclaimer Statement

Alternative Format Statement

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I. Background

Drone in a Box (DiaB) technologies are relatively new and there are only a handful of large companies that are manufacturing systems, thought the market is changing very rapidly. Many of these companies (Fig. 1) specialize in surveillance, security, and infrastructure, so they are not optimized (as far as the payloads) for natural disaster response or environmental observation. This will likely change over time, because there are multiple (non-DiaB) UAS disaster response solutions currently on the market.

One distinct limitation that we have in the largely rural, mountainous western US is the lack of widespread cellular connectivity. Many of these UAS systems depend on communications systems such as 4G/5G for data transfer, airspace situational awareness, and in the case of DiaB systems, remote connectivity. Satellite communications systems like Starlink have been utilized in different applications to provide connectivity in cellular "dead zones", but as far as we are aware Starlink has not been widely utilized to provide remote connectivity for remote DiaB operations.

Figure 1. The Skydio Drone in a Box System for the X10 UAS (Skydio, 2025).

There are a few goals that we set out to address in testing DiaB systems:

1) Do DiaB systems function in the extremes of temperature encountered in Montana?
2) Can DiaB systems function in remote cellular denied environments?
3) What are the performance differences and capabilities of some of the common DiaB systems on the market?
4) What are the networking concerns when operating DiaB systems?

In order to address these goals and ensure that we were following Federal Aviation Administration (FAA) regulations, we conducted a series of simulated beyond visual line of sight (BVLOS) with an onsite pilot in command (PIC), and multiple visual observers (VOs) to ensure all flights were within visual line of sight (VLOS). The power supply was provided by a Honda 1000W generator, the communications were provided by a Starlink antenna, and the control station was a laptop operated by the PIC. These simulations/demonstrations were intended to evaluate the remote functionality of DiaB systems within cellular connection and in cellular dead zones and in the summer and winter. The winter testing focused on the differences between DiaB system functionality with and without cell communication. And the summer testing focused on the differences between common DiaB systems on the market and their effectiveness at mapping potential natural hazards. We also conducted a preliminary network analysis of different DiaB communication software and systems.

These simulations took place in the extremes of temperature encountered in Montana (February and June). There was approximately 1 week of field testing in mid-summer, and 1 week in midwinter. Through this testing we developed standard operating procedures, training materials, developed knowledge transfer sessions, and provided some lessons learned in DiaB operations in challenging conditions. We developed video logs, and community outreach videos of the field tests to show verifiable proof that the operations were conducted in compliance with the FAA regulations, and also to aid in any troubleshooting, debriefing, analysis of unexpected behaviors or situations.

One of the longer term goals of this project (Phase II) is to develop a self-contained DiaB trailer to respond to natural disasters. Currently the only commercially of the shelf off-grid DiaB trailer system is made by an Australian company, Sphere Drones, for beyond visual line of sight (BVLOS) flights (Fig. 2), but this system is currently only available in Australia. This Sphere trailer system does not incorporate the communications systems, hazard sensor network, or interaction with the MDT Traffic Management System proposed for DiaB Phase II.

Figure 2. The Sphere Drones off-grid trailer solution (Sphere, 2025).

II. Field Testing

The Autonomous Aerial Systems Office (AASO) at the University of Montana (UM), the Montana Department of Transportation (MDT), and Frontier Precision conducted winter field testing in February of 2025 and summer field testing in June of 2025 of the DiaB systems. This testing was conducted in fully off-grid conditions inside and outside cellular dead zones. These operations were conducted with an on-site PIC and multiple VOs and completely within VLOS, but as a BVLOS simulation, evaluation, and demonstration in support of MDT’s application for a DiaB BVLOS waiver (Task 3).

The winter DiaB field tests took place during February 17-21, 2025, utilizing the Dock 2 system with a Mavic 3D UAS. Initial testing took place at the AASO office at the University of Montana and field testing took place at Maclay Flats about 5 miles SW of Missoula and at Bandy Ranch about 30 miles NE of Missoula. Snow depth was approximately 2 feet, temperature ranged from 20-42°F, and the average wind speed was 4mph (NWS, 2025).

The summer DiaB field tests took place during June 16-20, 2025, utilizing the Dock 2 with a Mavic 3D and a Skydio X10 system. Field testing took place in McNamara, about 15 miles east of Missoula, Fort Fizzle, about 15 miles southwest of Missoula, and Skalkaho Pass about 70 miles southeast of Missoula. The temperature ranged from 45-87°F, and the average wind speed was 6mph (NWS, 2025).

III. Photogrammetry Comparisons

There are a wide variety of sensor systems available on DiaB systems, but most of the systems have a red, green, blue (RGB) camera and some (mostly for public safety operations) also have a thermal camera. There are some manufacturers that sell dual photogrammetry/thermal systems (i.e. Mavic 3T) sometimes with lower resolution RGB cameras than the standard version (i.e. Mavic 3E). In RGB sensors used by most manufacturers, there are either electrical or mechanical shutters (Table 1). Mechanical shutters work with a physical blade or curtain, while electronic shutters use the electronic control of the sensor (lines of pixels in a row). Another distinction is a rolling shutter which exposes row by row, and a global shutter which exposes the whole image at the same time (Zmejevskis, 2023). There are tradeoffs in performance, cost, weight, and applications, but typically a global shutter is best for photogrammetry. The global shutters are typically not an option for smaller UAS. A rolling shutter can be affected by moving objects and can cause distortion in the imagery, but the technology improves year by year.

Specification	Skydio Dock with X10	Dock 2 with Mavic 3D	Dock 2 with Mavic 3T
Wide Camera	1", 50.3MP CMOS (no mechanical shutter)	4/3 20MP CMOS, mechanical shutter	0.5", 48MP CMOS (no mechanical shutter)
Telephoto Camera	0.5" 48MP CMOS	0.5", 12MP CMOS	0.5", 12MP CMOS
Narrow Camera	1/1.7" 64MP CMOS	xxx	xxx
Thermal Camera	FLIR Boson+ 640x512	xxx	VOx 640x520
Weight (lbs.)	5.5	3.1	2.31
Max Flight Time	40	50	45

Table 1. The camera specifications for the DiaB UAS utilized in this study.

This study analyzed the photogrammetric modeling performance of the Skydio X10 and the Mavic 3D. We compared flights on the same day and location, with similar flight altitudes, speeds, and image overlaps. We processed the flights using Pix4D Mapper (Version 4.10) into digital surface models (DSMs) and orthomosaics (Pix4D, 2025). The DSM's and orthomosaics were then imported into ArcGIS Pro (Version 3.5) to create hillshades and perform analysis. Due to time constraints, these flights did not utilize ground control surveys or real-time kinematic global navigation satellite system (GNSS) corrections, so the absolute root mean square (RMS) and model accuracy could not be calculated.

Photogrammetry flights were conducted with the Skydio X10 and Mavic 3D in McNamara, MT on June 17, 2025 (Fig. 3). Details of man-made objects (Fig. 4) and natural features (Fig. 5) show some of the differences in image overlap, point density, color, and contrast. On June 18, 2025, we conducted a series of flights at Fort Fizzle, MT targeting a ravine and steep slope north of Highway 93. Then on June 19, 2025, we flew near Skalkaho Pass, MT at a series of slopes adjacent to areas that burned in 2024. The flight specifications are listed in Table 1. Many other examples of these side by side comparisons of 3D model orthomosaics as well as a table of flight specifications and model performance are show in Appendix B.

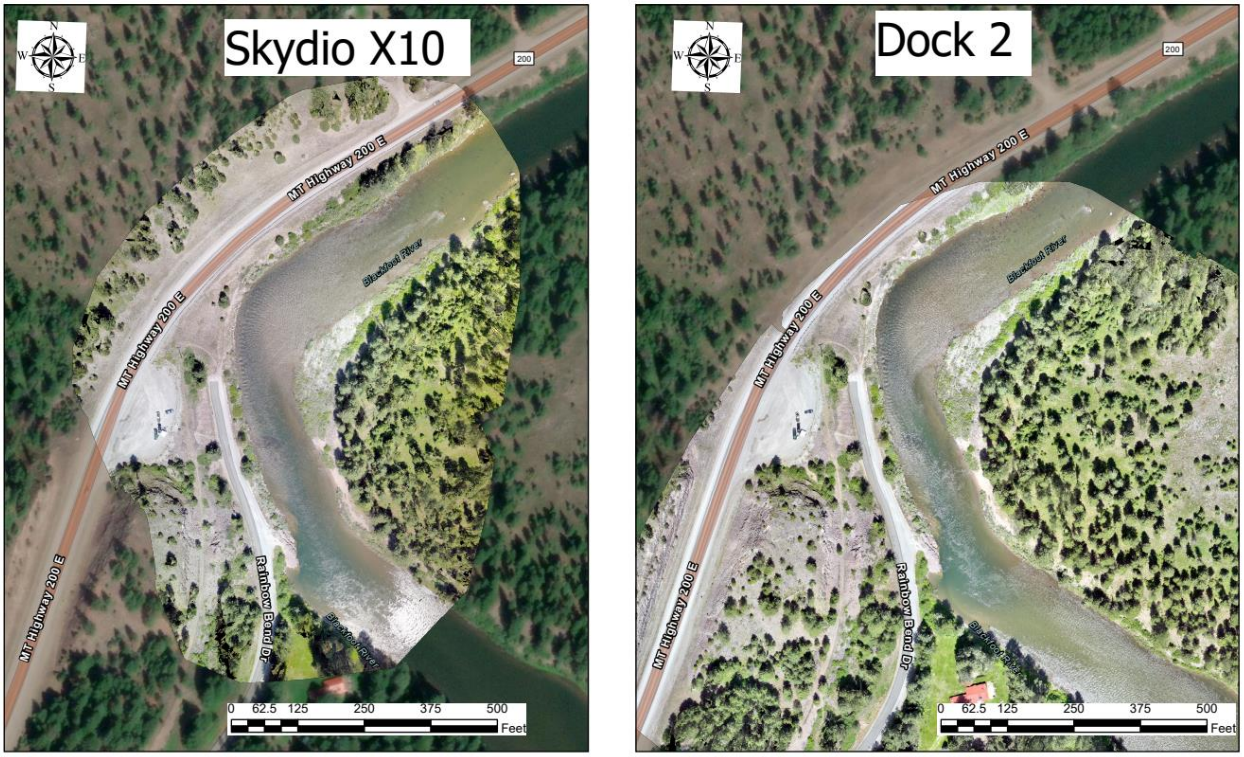


Figure 3. A side by side comparison of a RGB photogrammetry survey at McNamara, MT.

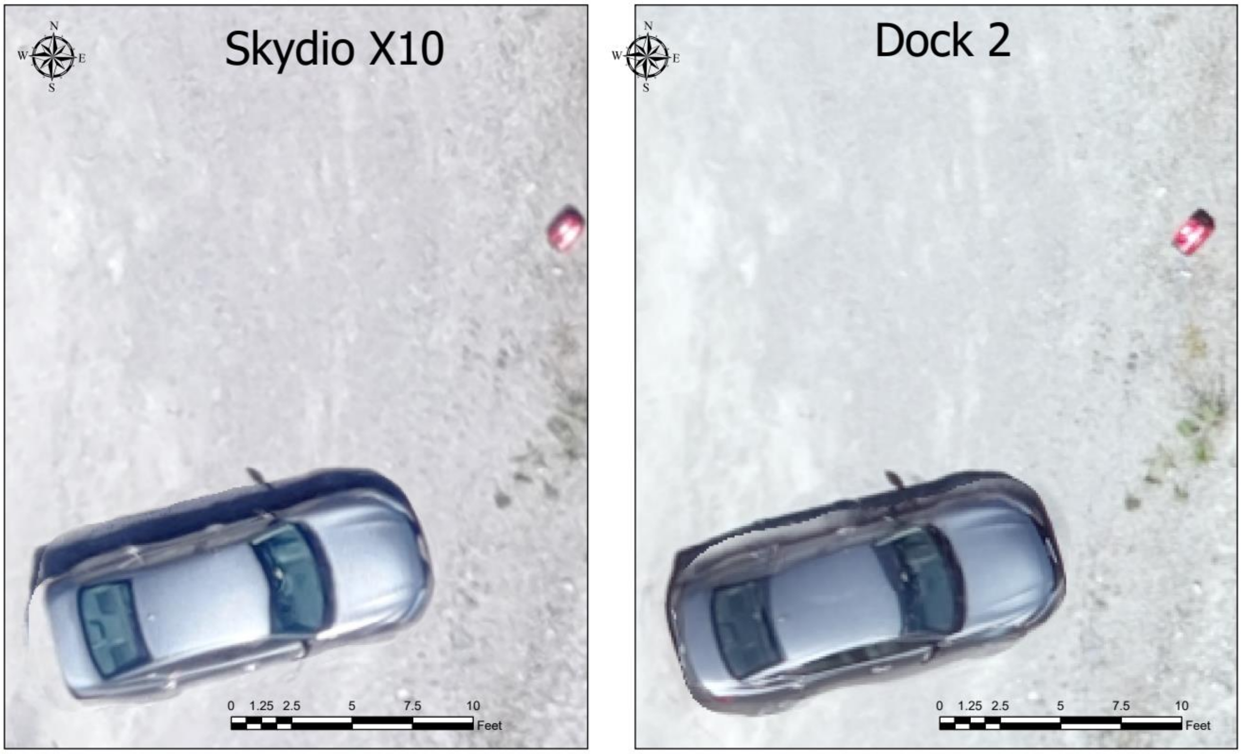


Figure 4. A detailed side by side view of a photogrammetry survey in McNamara showing the 3D model reconstruction of a car and a generator at the upper right.

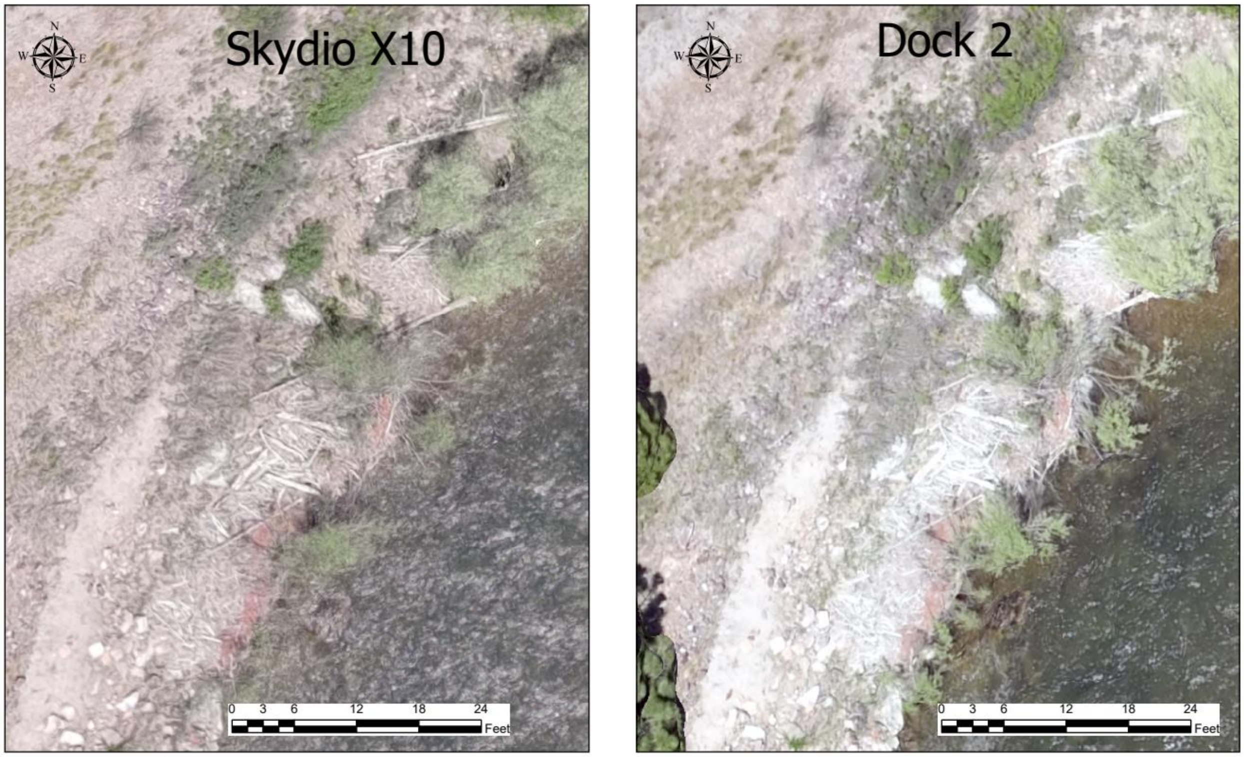


Figure 5. A detailed comparison of the natural features along the edge of the Blackfoot River in McNamara.

It is typical in UAS photogrammetry to have edge effects (distorted or missing data along the edges) usually due to a lack of images covering the area surrounding the survey. Most of the time researchers will clip out these distortions, but in this case, we left them in place to show the magnitude of edge effects for each system. Another typical cause of distortions is wind blowing trees, this causes the software to have trouble finding keypoints to process the images. On all of the days we tested the DiaB systems the winds were light to moderate, so distortions should be minimal. Another cause of distortions could be flight plans (Fig. 6- bottom right on the Dock 2 and Fig. 7- center Dock 2) that do not have complete coverage of an area with changing topography.

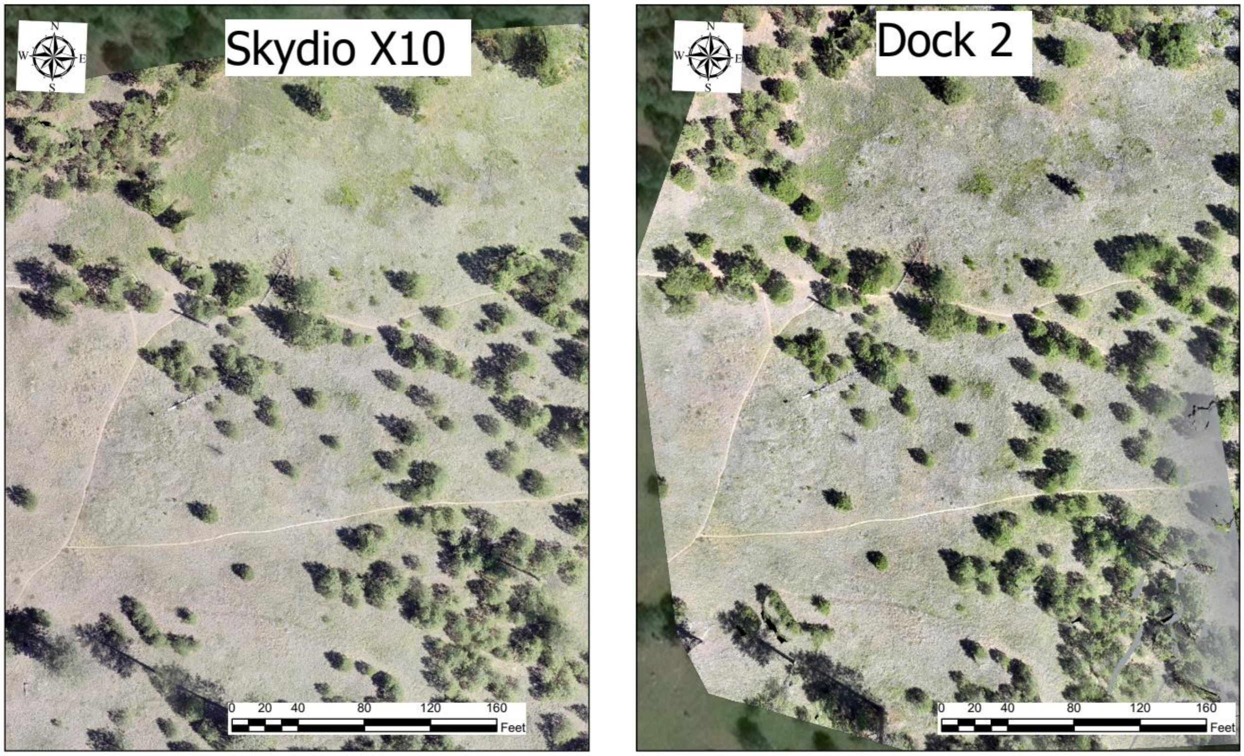


Figure 6. A comparison of a photogrammetry model at Fort Fizzle.

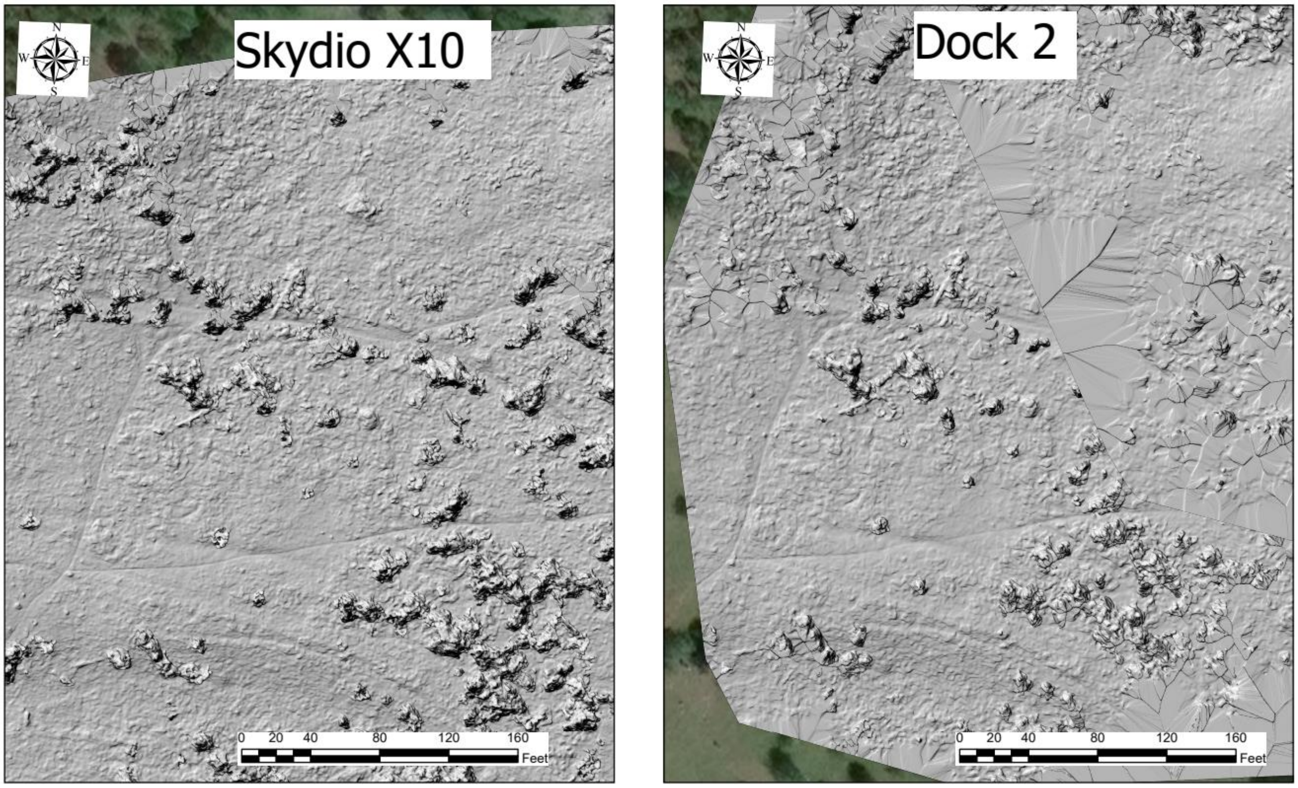


Figure 7. A detail of the digital surface model (DSM) of a photogrammetry survey at Fort Fizzle.

IV. Network Analysis

There is increasing concern about the threat of data and communications being used by bad actors for malicious purposes. Many organizations are starting to shift from non-allied foreign-made UAS to National Defense Authorization Act (NDAA) compliant UAS. As this shift occurs there are some software developers (i.e. Flytbase, 2025) that have sought to provide more secure communications for UAS operators and organizations currently utilizing allied and non-allied UAS. DiaB systems are built on a foundation of utilizing communications to operate a UAS from remote locations. These DiaB communications can occur over satellite, fiber optic, cellular, radio, mesh networks and Wifi. One method of analyzing communications is the use of packet analysis on networks.

We utilized an open source packet analysis software program called Wireshark (Version 4.4) to analyze the network traffic for a few DiaB systems/configurations (Wireshark, 2025). Three configurations were analyzed: Dock 2 with FlightHub, Dock 2 with Flytbase, and Skydio with Skydio Remote Ops. After communications were established (connected ethernet, Wifi, etc.) the network packets were recorded with Wireshark. An open source database was utilized to find the location of the destination IP address (MaxMind, 2025). This method allows the detection of the IP address, but that does not conclusively determine the location of the network traffic, because IP addresses can be obscured or redirected, but it is a starting point to identify the pathways of the network traffic.

Source	**Destination IP Locations**	**Affiliation**
Dock 2/FlightHub	Secaucus, NJ	Cogent Communications
	Los Angeles, CA	Zenlayer Inc.
	Vancouver, WA	Cisco Open DNS
	Seattle, WA	Zenlayer Inc.
Dock 2/Flytbase	Los Angeles, CA	Zenlayer Inc.
	Elk Grove Village, IL	Agora/GTT Communications
	Ashburn, VA	Amazon Data Services NoVa
	Seattle, WA	Akamai International
	Paris, France	Microsoft
Skydio/Remote Ops	Portland, OR	Amazon AWS
	Columbus, OH	Amazon AWS
	Cheyene, WY	Microsoft

Table 2. The Destination IP results of the packet analysis.

V. Conclusions

This research investigated the use of DiaB performance in extreme weather conditions and in cellular and cellular-denied environments, mapping abilities, and communications. We evaluated two commonly available DiaB systems (Dock 2 with Mavic 3D and Skydio X10) and determined that both performed well in all conditions. We did not evaluate the spatial or 3D model accuracy of the systems for photogrammetry, but we evaluated their performance in similar conditions. We investigated 3 systems for network communications: Dock 2 with FlightHub, Dock 2 with Flytbase, and Skydio X10 with Skydio Remote Ops. The network analysis revealed that all 3 were communicating with cloud service providers in the US (and in one case France). This research provides the groundwork for the Phase II DiaB project.

Both the Dock 2 with the Mavic 3D and Skydio X10 performed without issue in both cold and hot temperatures. During the winter, operating with a generator there were no observable differences with UAS battery or flight time reductions. There was also no observable video or UAS control lag due to running the system off-grid. The IP rating seems to be as advertised as we flew in light snow one of the days. During the summer, we did not observe any degradation in performance with altitude (with the range of 3200-5800’ MSL) or overheating with either system.

There were some lessons learned during the fieldwork. One important consideration is that Starlink (currently) does not provide enough bandwidth to run both the ground control system and the DiaB system concurrently. There were notable lags in the video feed, but no observable limits to the control or operation of the UAS. In true BVLOS operations, this would likely not be an issue because the PIC would be operating the ground control on a laptop or PC from an office or home office with wired communication, so the Starlink would only be controlling the DiaB. We fixed this issue in the field by running two separate Starlink antennas.

Although both systems operate as advertised for automated photogrammetry flights, there are some small differences in the onboard sensor systems that are observable in the processed 3D models. In bright sunlight and in natural features, the Skydio seemed to have slightly better color balancing and contrast that enabled better discrimination of small features (i.e. downed trees and bushes next to the Blackfoot River. Also, probably because the Skydio wide angle camera has a slightly higher resolution (50.3MP) than the Mavic 3D (48MP) there was an observable and consistently higher point density (avg. point density per m^3). Another difference that was observable in the 3D photogrammetry models is that the GPS in the Mavic 3D seems to be consistently more accurate than the Skydio. Probably if the Skydio were operating with RTK or with local base station corrections these values would improve. Also, the flight planning with terrain awareness is not available currently on the Skydio, so it is possible to fly tiered flights in complex topography, but it is really time consuming to plan.

Future work should compare the systems with just the onboard GPS versus utilizing RTK and local base station corrections and installing a network of GNSS surveyed ground control points and check points. With the ground control the absolute accuracy of the 3D models can be calculated. Another thing that could be investigated is the performance and accuracy of the Skydio X10 and the Mavic 3T thermal sensors.

The MDT was provided with an ArcGIS Pro map package with all of the data collected and the individual photogrammetry surveys are available through the links below.

Location	Equipment	Sensor	URL- View
McNamara	Dock 2	RGB	https://cloud.pix4d.com/dataset/2268686/map?shareToken=d4893a72-a65d-403d-871f-a538a37965f8
McNamara	Skydio X10	RGB	https://cloud.pix4d.com/dataset/2268674/map?shareToken=46fc94a1-6602-460e-a0ea-67bce2fd046b
Fort Fizzle Map	Dock 2	RGB	https://cloud.pix4d.com/dataset/2268814/map?shareToken=8e3cede0-e30e-4d82-9695-814607facb51
Fort Fizzle Slope	Dock 2	RGB	https://cloud.pix4d.com/dataset/2268690/map?shareToken=afd02143-8dee-485d-9f7a-2cab7cef6ab3
Fort Fizzle	Skydio X10	RGB	https://cloud.pix4d.com/dataset/2268805/map?shareToken=f3dcc13d-6a92-42f3-a697-ea73bf2b0109
Skalkaho Slope	Dock 2	RGB	https://cloud.pix4d.com/dataset/2268812/map?shareToken=c93a7ea9-1fa6-4e1d-9a92-f157f3bb3397

Skalkaho River	Dock 2	RGB	https://cloud.pix4d.com/dataset/2272210/map?shareToken=84aa2d7c-3401-4ce7-807b-f988888f3483
Skalkaho River	Skydio X10	RGB	https://cloud.pix4d.com/dataset/2270578/map?shareToken=0e182d85-6690-49e2-8b4e-388096615179

VI. Acknowledgements

The authors would like to sincerely thank the Montana Department of Transportation (MDT) and Technical Panel (TP) for their time and effort reviewing the work plan and timeline, providing guidance on the analysis and reports, providing logistical support, and steering the research. We’d also like to thank Trevor Hoggatt and Collin Kemmesat from Frontier Precision (FP) for their logistical and field support. Without the TP and FP support this research would not have been possible.

Technical Panel Members:
Emily Hawley, Research and Project Manager, MDT; Rebecca Ridenour, Research Program Manager, MDT; Mike Kuni, Project Chair, MDT; Paul Hilchen, UAS Manager, MDT; Curtis Buckley, Technical Panel Member, MDT; Lee Grosch, Technical Panel Member, MDT; Justun Juelfs, Technical Panel Member, MDT; Cameron Kloberdanz, Technical Panel Member, MDT; Patrick McCann, Technical Panel Member, MDT; Ethan Ritzen, Technical Panel Member, MDT; Patrick Dryer, Technical Panel Member, AKDOT; Stephanie Brandenberger, Technical Panel Member, FHWA; Raja Nagisetty, Technical Panel Member, Montana Tech

VII. References

ESRI, 2025. https://pro.arcgis.com/en/pro-app/latest/get-started/download-arcgis-pro.htm. Accessed June 14, 2025.

Flytbase, 2025. Enterprise AI platform for drone autonomy. http://flytebase.com. Accessed June 12, 2025.

MaxMind, 2025. MaxMind GeoIP databases. https://www.maxmind.com/en/geoip-databases. Accessed June 20, 2025.

NWS, 2025. National Weather Service NOAA, US Department of Commerce. US Local Climatological Data. https://www.ncei.noaa.gov/cdo-web/datatools/lcd. Accessed June 23, 2025.

Pix4D, 2025. https://support.pix4d.com/hc/en-us/articles/115005738363. Accessed June 14, 2025.

Skydio, 2025. https://www.skydio.com/dock. Accessed June 12, 2025.

Sphere, 2025. https://www.spheredrones.com.au/. Accessed June 12, 2025.

Zmejevskis, L. 2023. Electronical vs. mechanical shutter in detail. https://www.pix-pro.com/blog/shutter. Accessed June 14, 2025.

VIII. Appendix A: Fieldwork Standard Operating Procedures and Locations

1) Winter DiaB Testing, Week of February 17, 2025, Equipment: Dock 2

Cellular Location, Maclay Flats. (WGS84, 46.831532°, -114.104581°) (Fig. 8)
Cellular Denied Location, Bandy Ranch, East of Missoula, along Hwy 200. (WGS84, 47.059591°, -113.260824°) (Fig. 9)

- Step 1: Check system status with 120v power to DiaB, pilot in VLOS
    - Set up exterior video recording system to document/log procedures, start recording
    - Establish cellular communication
    - Check to see if Wifi communication is an option
    - Check internal DiaB video connection
    - Check weather station status
    - Check to see if there is delay in communications
    - Check GPS connectivity
    - Check status of communications and self-check
    - Check status of FlyteBase communications
- Step 2: Check UAS functionality
    - Remotely start propellers
    - Take off and ascend to 20’ AGL, then descend to 10’ AGL
    - Check forward, backward, left, right, and left/right rotation
    - Move forward 50’
    - Engage return to home
- Step 3: Check UAS performance (still within VLOS)
    - Start onboard UAS video
    - Take off and ascend to 400’ AGL
    - Fly 400’ to the East (towards Mt. Sentinel)
    - Return to start point (at 400’ AGL)
    - Fly 400’ to the West
    - Return to start point
    - Fly 400’ to the North
    - Return to start point
    - Fly 400’ to the South
    - Return to start point
    - Manually land
    - Stop onboard video
- Step 4: Advanced UAS performance, VOs stationed with radio coms, PIC utilizing daisy chain observation in central location (UM Oval)
    - Start onboard UAS video
    - Take off and ascend to 400’ AGL
    - Fly 3000’ to the East (towards Mt. Sentinel)
    - Return to start point (at 400’ AGL)
    - Fly 3000’ to the West
    - Return to start point
    - Fly 3000’ to the North
    - Return to start point

  - Fly 3000’ to the South
  - Trigger RTH to land
  - Stop onboard video
- Step 5: Advanced Communication Analysis
  - Check communications using network analysis software (i.e. Wireshark)
  - Look up outgoing networking coms
  - Record network traffic
  - Check ISP address
  - Enable FlyteBase
  - Look up outgoing networking coms
  - Record network traffic
  - Check ISP address

The within cellular field testing will occur on UM campus at the AASO office and at Maclay Flats SW of Missoula. The cellular denied environment field testing will occur at McNamara on Hwy 200 east of Missoula in the Verizon cellular dead zone. Frontier Precision will assist in the DiaB testing and provide a Dock 2 along with FlightHub and FlyteBase software to ensure secure communications. The testing will utilize a generator for power and Starlink for communication (UM provided).

Video flight logs will capture the field testing. These video logs will provide a record of any unexpected circumstances, unusual UAS flight behaviors encountered, the flight operations were conducted as planned, the UAS equipment behaved as expected, and no unusual circumstances were encountered.

The field testing for Task 4 will evaluate whether or not the research team properly prepared and anticipated all the necessary equipment to perform the field testing. We will also evaluate the potential risks to the flight operations (magnetic interference, communications, GPS outages, weather concerns, etc.). Finally, we will determine if we documented the flight testing in adequate detail to troubleshoot or modify methods in the case of unsuccessful operations. At the conclusion of the winter and summer field testing we will provide a section of the report that will detail the lessons learned and any recommendations for future research.

Test Locations:

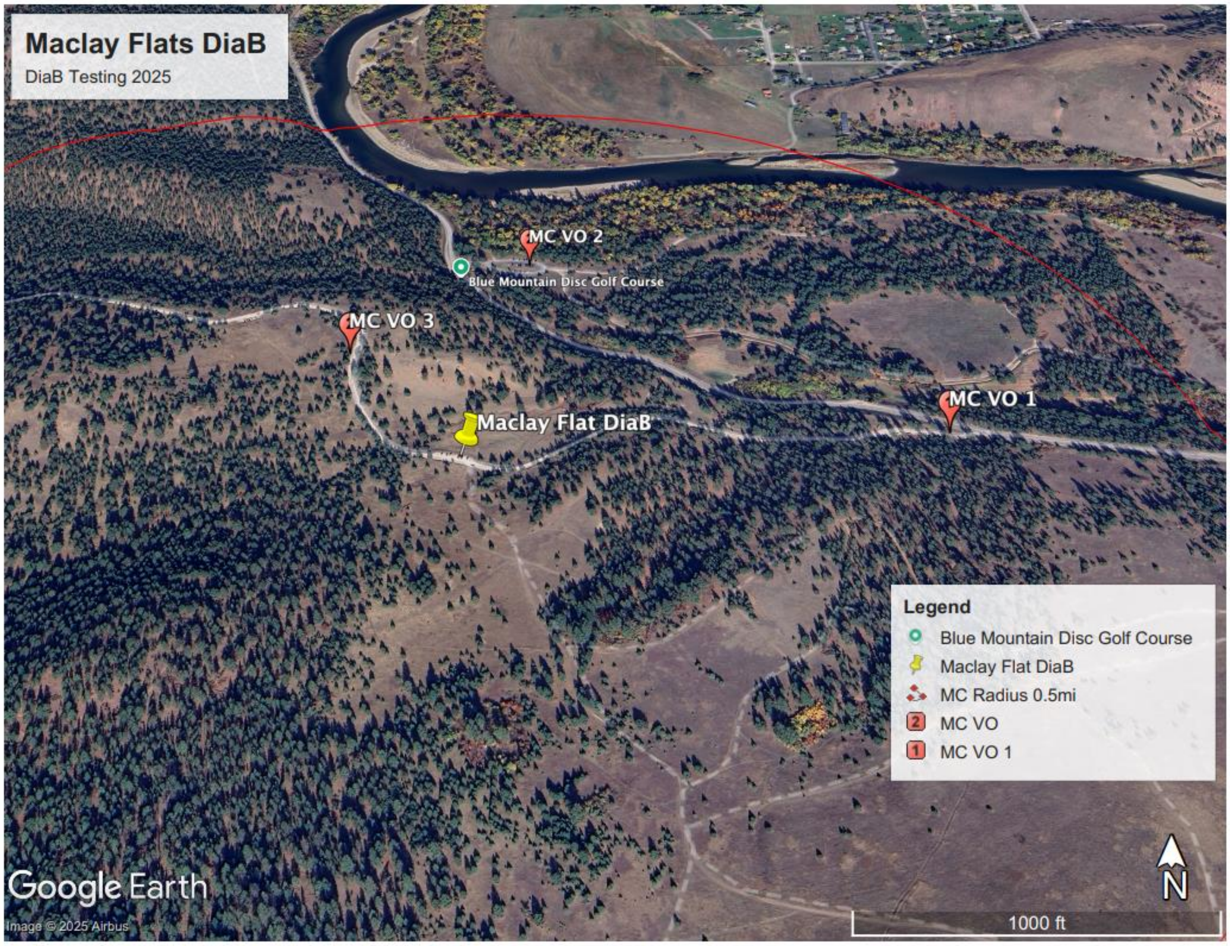


Figure 8. Winter DiaB test location. Maclay Flats, SW of Missoula. DiaB Testing in cellular conditions.

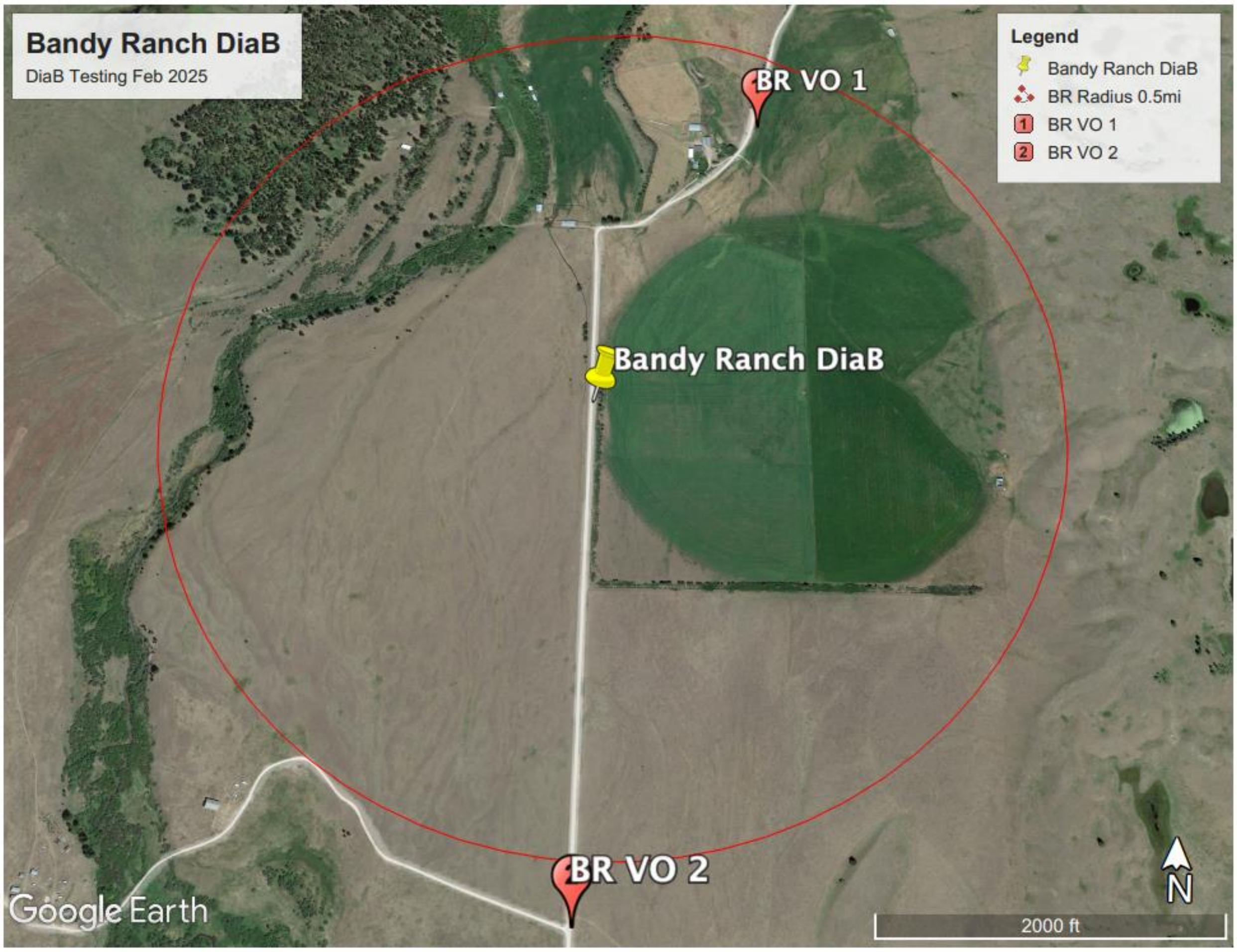


Figure 9. Winter DiaB test location. Bandy Ranch, NE of Missoula. DiaB testing in cellular-denied conditions.

2) Summer DiaB Testing, Week of June 16th, 2025, Equipment: Dock 2 and Skydio X10

Locations (Detailed Maps Below):

- Location 1: McNamara- Slope Site (46.907946, -113.683014), Approx. 20 Minutes from UM (Fig. 10)
- Location 2: Fort Fizzle- Lolo Pass Area- Low Cell Coverage (46.746235, -114.172550), Approx. 30 Minutes from UM (Fig. 11)
- Location 3: Skalkaho- Slope and Burn Site (46.223004, -113.849037), Approx. 1.5 hrs from UM (Fig. 12)
-
- Step 1: Check system status with 120v power to DiaB, pilot in VLOS
    - Set up exterior video recording system to document/log procedures, start recording
    - Establish cellular communication
    - Check to see if Wifi communication is an option
    - Check internal DiaB video connection
    - Check weather station status
    - Check to see if there is delay in communications

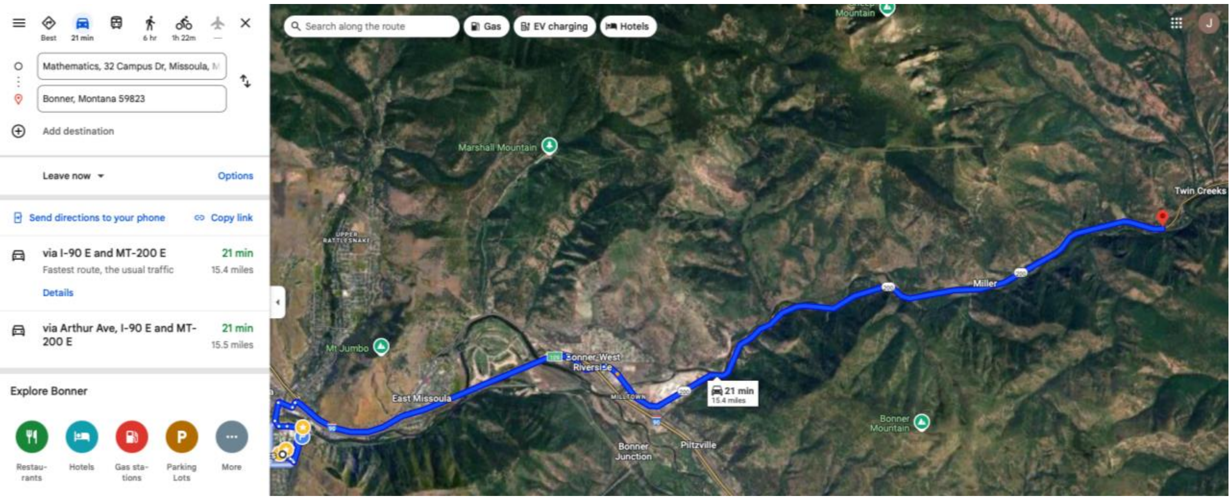
  - Check GPS connectivity
  - Check status of communications and self-check
  - Check status of FlyteBase communications
- Step 2: Check UAS functionality
  - Remotely start propellers
  - Take off and ascend to 20’ AGL, then descend to 10’ AGL
  - Check forward, backward, left, right, and left/right rotation
  - Move forward 50’
  - Engage return to home
- Step 3: Advanced UAS performance, VOs stationed with radio coms, PIC utilizing daisy chain observation in central location
  - Start onboard UAS video
  - Take off and ascend to 400’ AGL
  - Fly 3000’ to the East
  - Return to start point (at 400’ AGL)
  - Fly 3000’ to the West
  - Return to start point
  - Fly 3000’ to the North
  - Return to start point
  - Fly 3000’ to the South
  - Trigger RTH to land
  - Stop onboard video
- Step 4: Photogrammetry flights of Slopes, Burns, or Project Area
  - Program flight path using Pilot 2 App on ground control station
  - Target coverage approximately 25 acres
  - Target altitude 400’
  - Target overlap 70% side and front
  - Ensure flight time is less than 30 minutes
  - Verify there are no obstacles to the flight
  - Execute automated photogrammetry flight
- Step 6: Skydio Remote Access
  - Ensure remote connectivity to X10 via laptop
  - Repeat step 2 (Check UAS Functionality)
  - Repeat Step 5 (Photogrammetry Flight)
- Step 7: Advanced Communication Analysis at AASO Office
  - Check communications using network analysis software (i.e. Wireshark)
  - Look up outgoing networking coms
  - Record network traffic
  - Check ISP address
  - Enable FlyteBase
  - Look up outgoing networking coms
  - Record network traffic
  - Check ISP address

The winter field testing was completed in Feb 2025 and summer field testing will take place the week of June 16th, 2025. These field tests will have video logs to show verifiable proof that the operations were conducted in compliance with the FAA regulations, and also to aid in any troubleshooting, debriefing, analysis of unexpected behaviors or situations, etc.

The cellular denied environment field testing will occur at McNamara, Fort Fizzle, and Skalkaho Road in cellular dead zones. Frontier Precision (FP) will assist in the DiaB testing and provide a Dock 2 and FlyteBase software to ensure secure communications. FP will also bring a Skydio X10 to test remote access to the UAS. The testing will utilize a generator for power and Starlink for communication (UM provided).

Video flight logs will capture the field testing. These video logs will provide a record of any unexpected circumstances, unusual UAS flight behaviors encountered, the flight operations were conducted as planned, the UAS equipment behaved as expected, and no unusual circumstances were encountered.

Field Locations:



Mathematics, 32 Campus Dr, Missoula, M

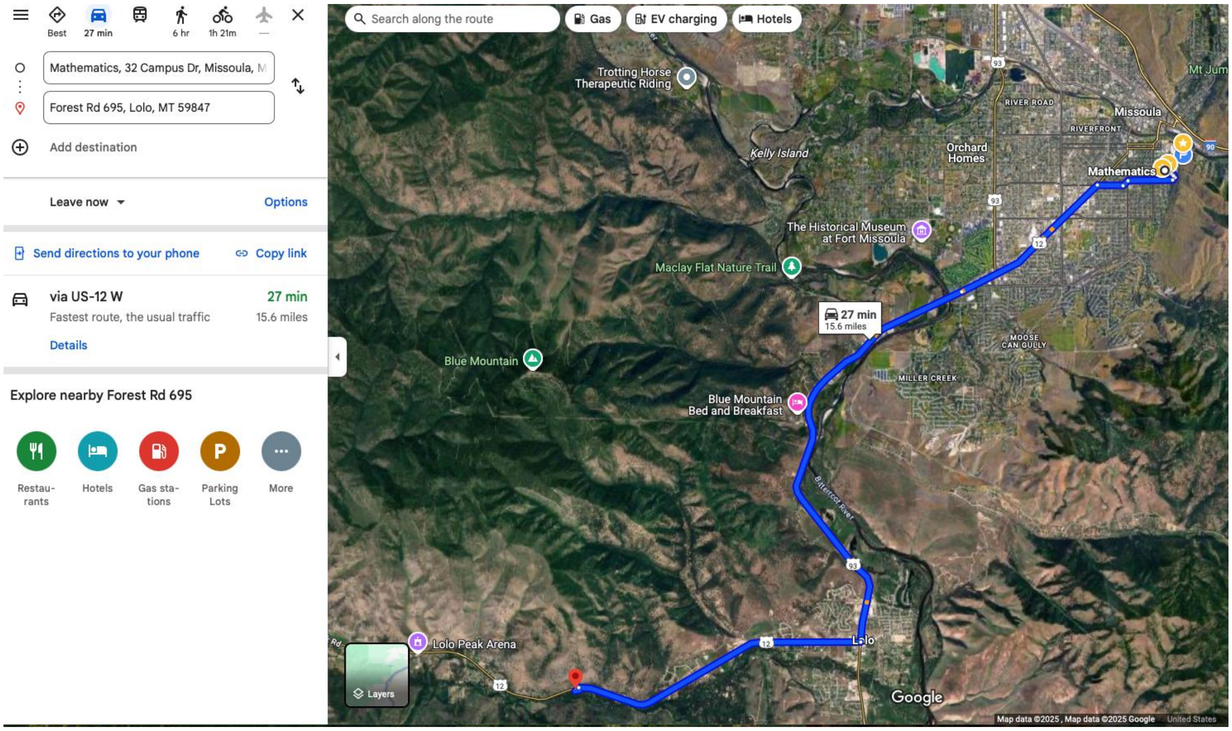
Bonner, Montana 59823

Leave now

via I-90 E and MT-200 E 21 min
Fastest route, the usual traffic 15.4 miles

via Arthur Ave, I-90 E and MT-200 E 21 min
15.5 miles

Figure 10. Summer DiaB testing location. McNamara slope site.



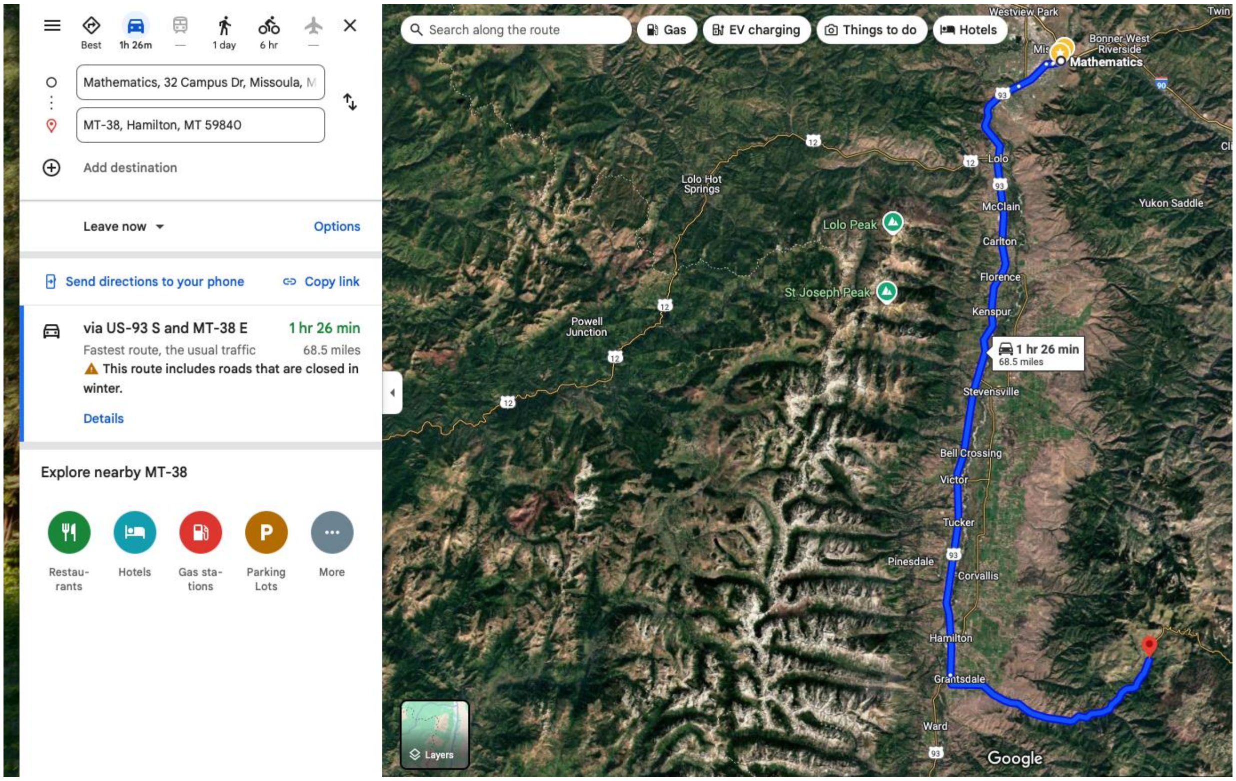
Mathematics, 32 Campus Dr, Missoula, M

Forest Rd 695, Lolo, MT 59847

Leave now

via US-12 W 27 min
Fastest route, the usual traffic 15.6 miles

Figure 11. Summer DiaB testing location. Fort Fizzle near Lolo, low cell coverage area.



Mathematics, 32 Campus Dr, Missoula, M

MT-38, Hamilton, MT 59840

Leave now

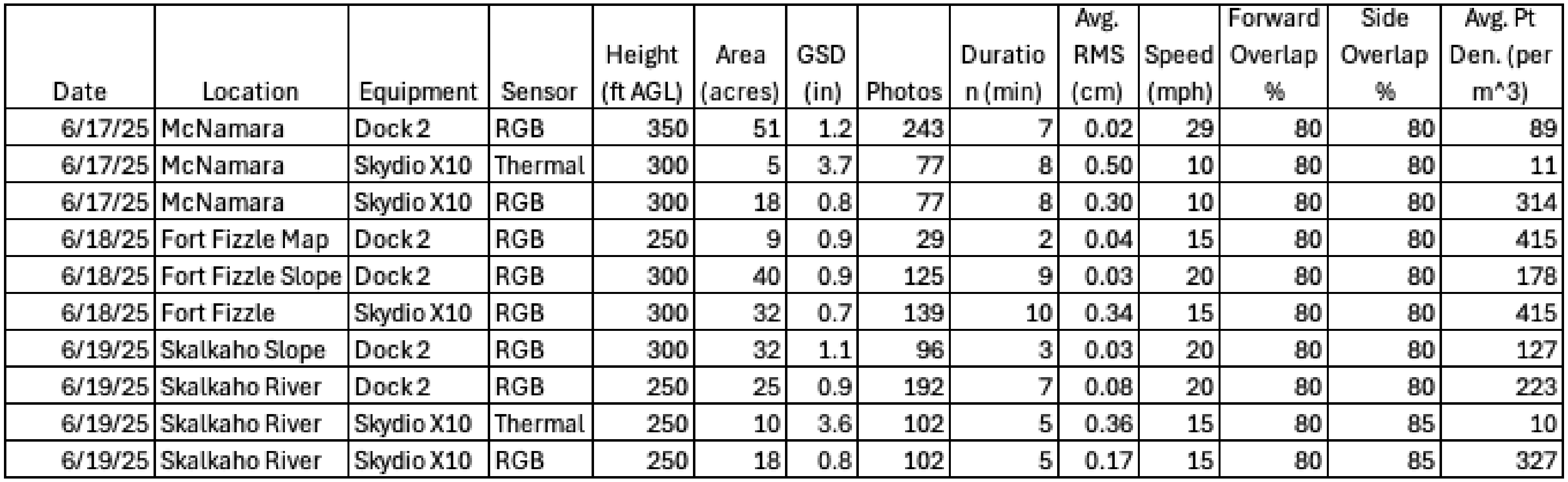
via US-93 S and MT-38 E 1 hr 26 min

Fastest route, the usual traffic 68.5 miles

⚠ This route includes roads that are closed in winter.

Figure 12. Summer DiaB testing location. Skalkaho Pass, slope and burn site.

IX. Appendix B: Photogrammetry Comparison



Date	Location	Equipment	Sensor	Height (ft AGL)	Area (acres)	GSD (in)	Photos	Duratio n (min)	Avg. RMS (cm)	Speed (mph)	Forward Overlap %	Side Overlap %	Avg. Pt Den. (per m^3)
6/17/25	McNamara	Dock 2	RGB	350	51	1.2	243	7	0.02	29	80	80	89
6/17/25	McNamara	Skydio X10	Thermal	300	5	3.7	77	8	0.50	10	80	80	11
6/17/25	McNamara	Skydio X10	RGB	300	18	0.8	77	8	0.30	10	80	80	314
6/18/25	Fort Fizzle Map	Dock 2	RGB	250	9	0.9	29	2	0.04	15	80	80	415
6/18/25	Fort Fizzle Slope	Dock 2	RGB	300	40	0.9	125	9	0.03	20	80	80	178
6/18/25	Fort Fizzle	Skydio X10	RGB	300	32	0.7	139	10	0.34	15	80	80	415
6/19/25	Skalkaho Slope	Dock 2	RGB	300	32	1.1	96	3	0.03	20	80	80	127
6/19/25	Skalkaho River	Dock 2	RGB	250	25	0.9	192	7	0.08	20	80	80	223
6/19/25	Skalkaho River	Skydio X10	Thermal	250	10	3.6	102	5	0.36	15	80	85	10
6/19/25	Skalkaho River	Skydio X10	RGB	250	18	0.8	102	5	0.17	15	80	85	327

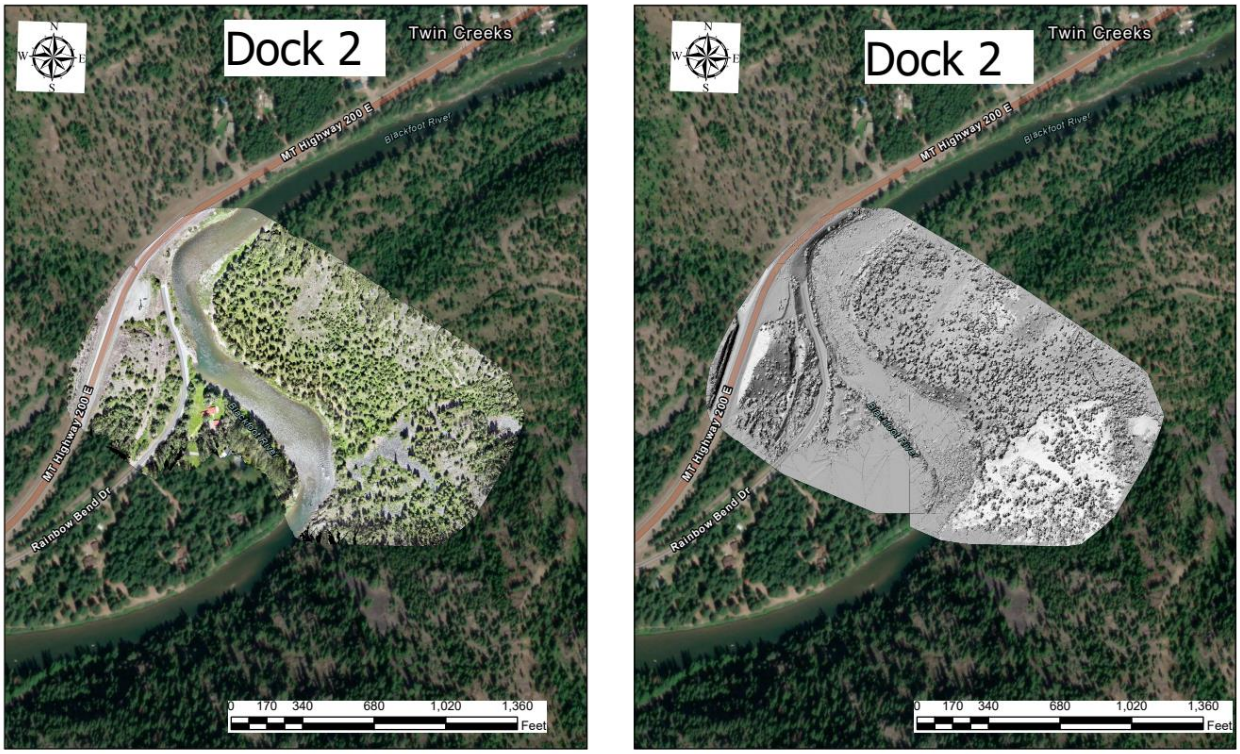


Figure 13. A side by side comparison of an RGB orthomosaic and a DSM-derived hillshade at McNamara with the Dock 2 system.

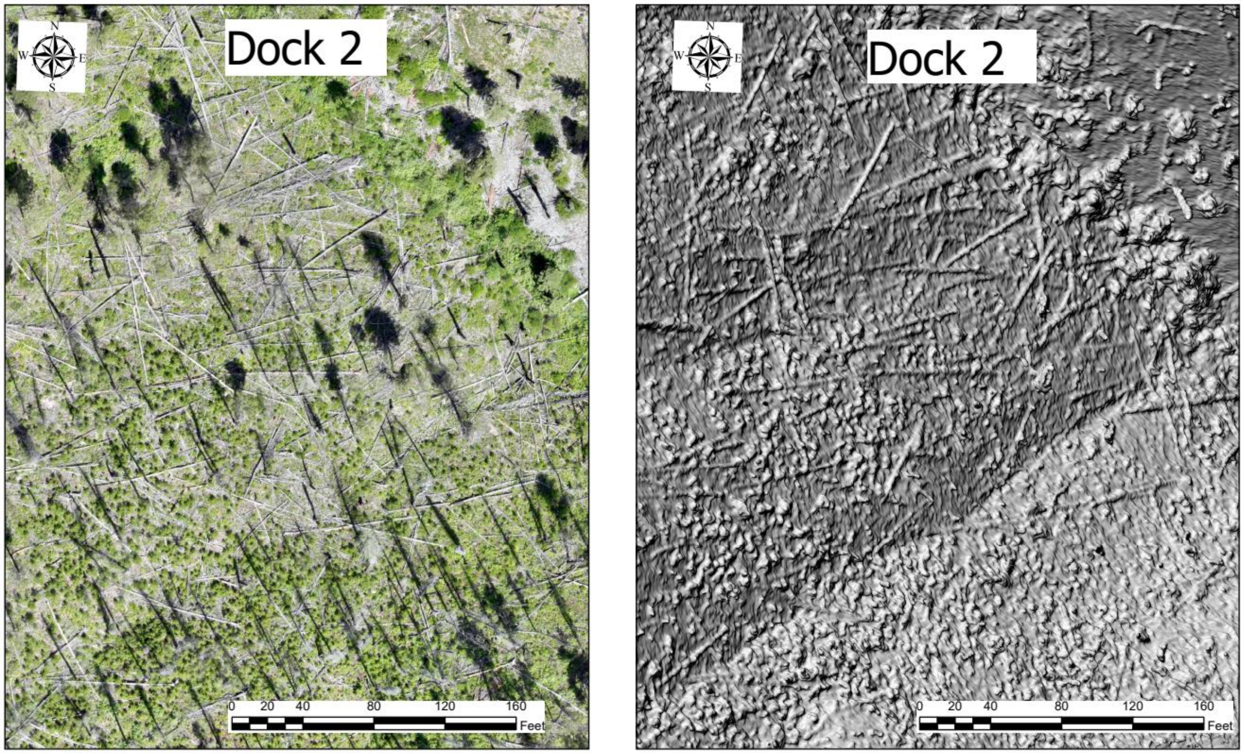


Figure 14. A detail of the RGB ortho and hillshade from the Dock 2 system at Fort Fizzle showing a steep slope with downed trees.

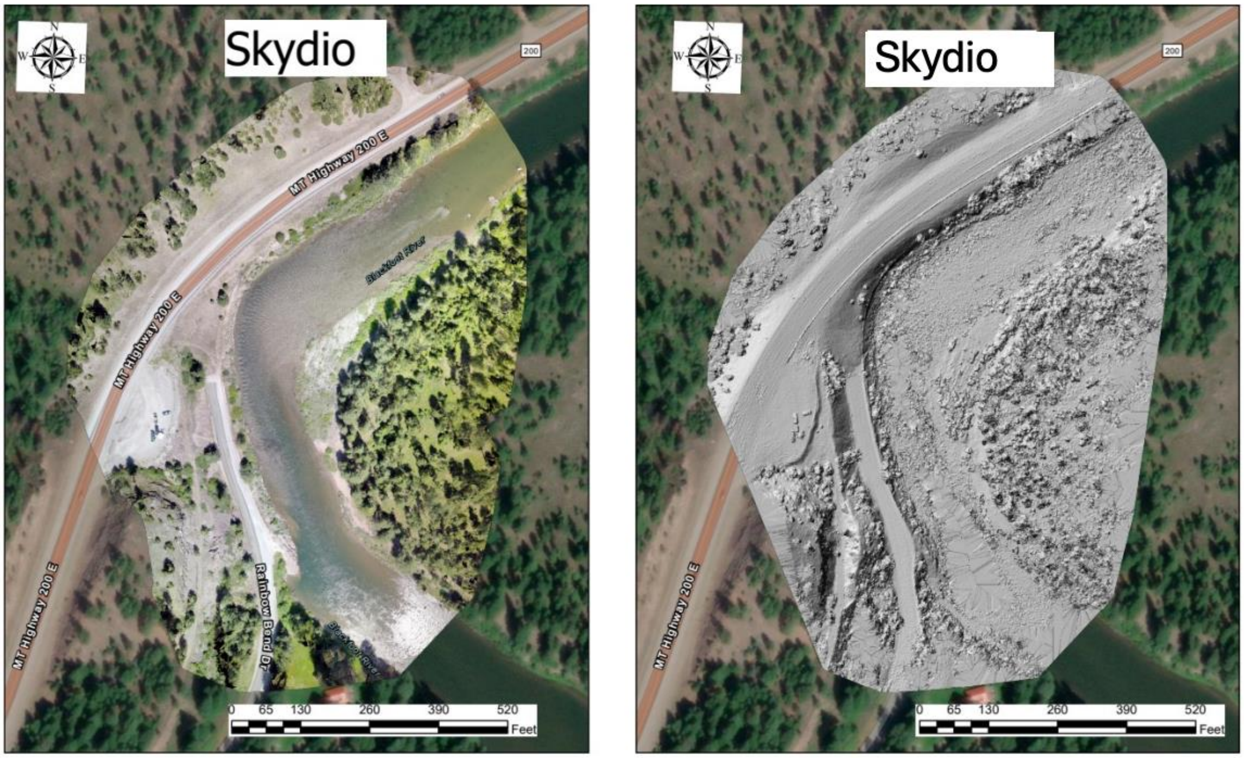


Figure 15. A comparison of the Skydio orthomosaic and hillshade from McNamara.

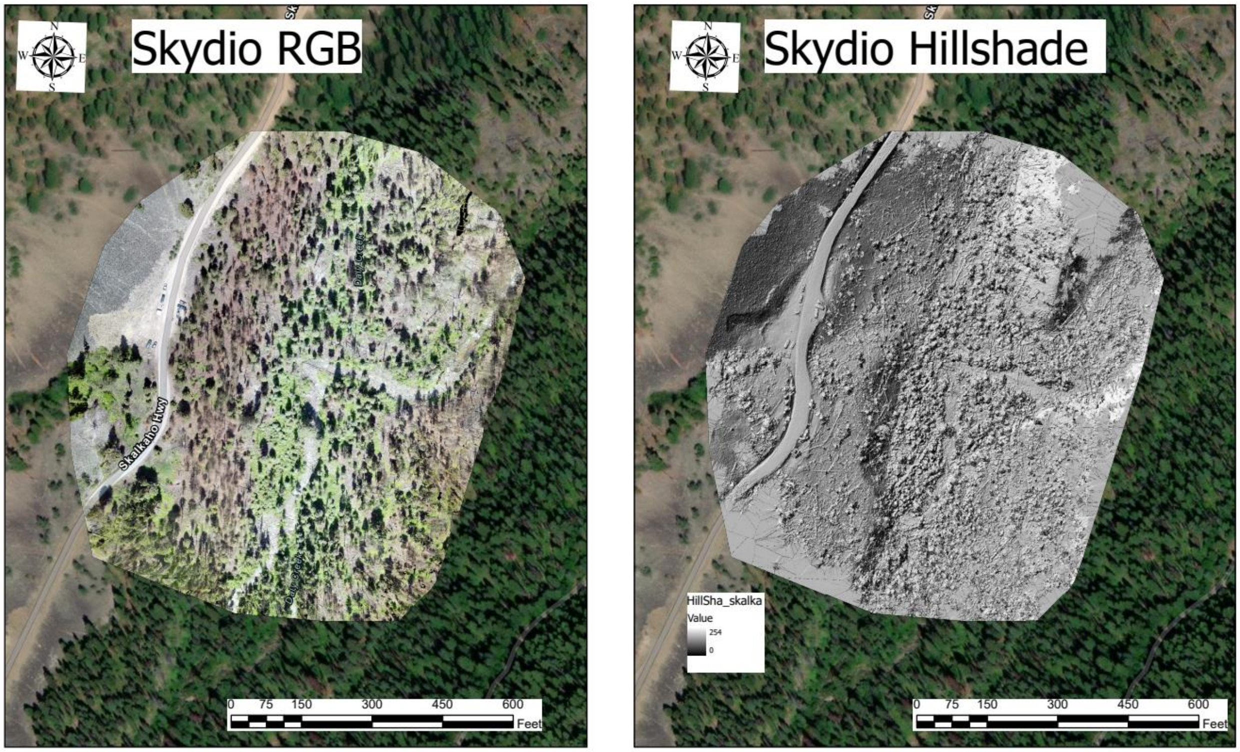


Figure 16. The Skydio orthomosaic and hillshade from the Skalkaho slope area.

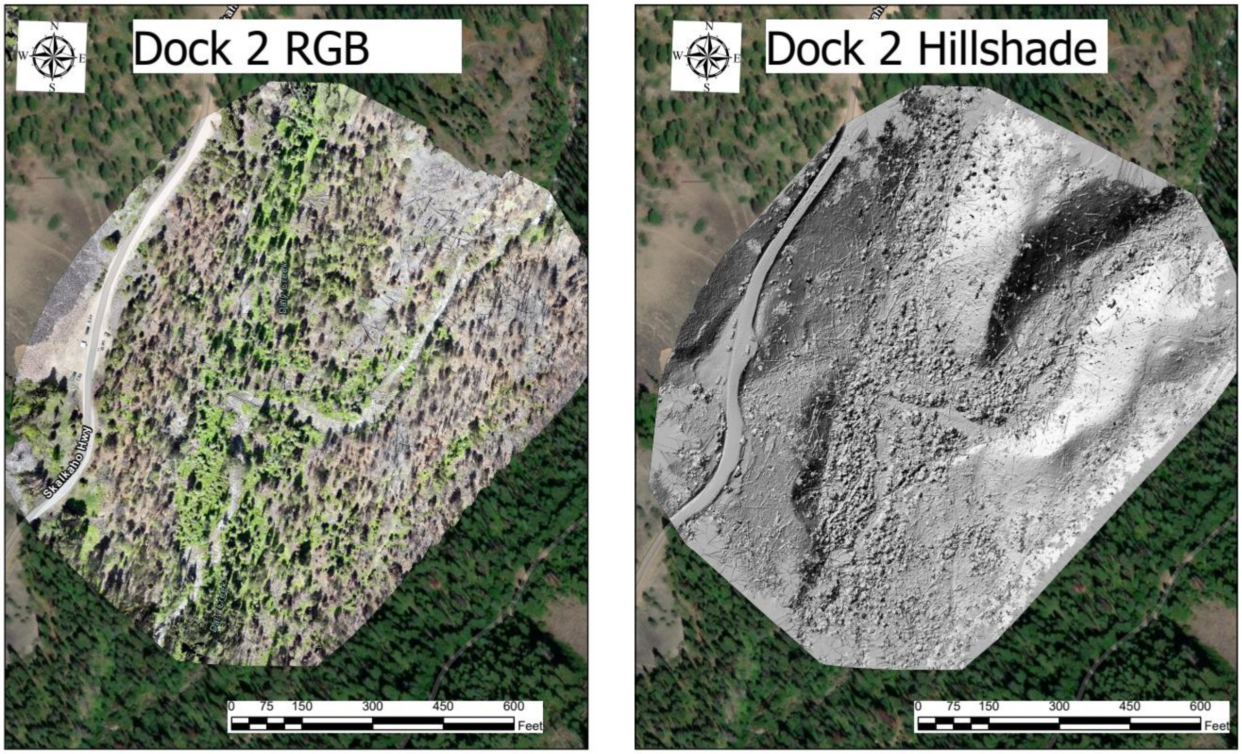


Figure 17. This is an orthomosaic and hillshade of the Skalkaho River site with the Dock 2.

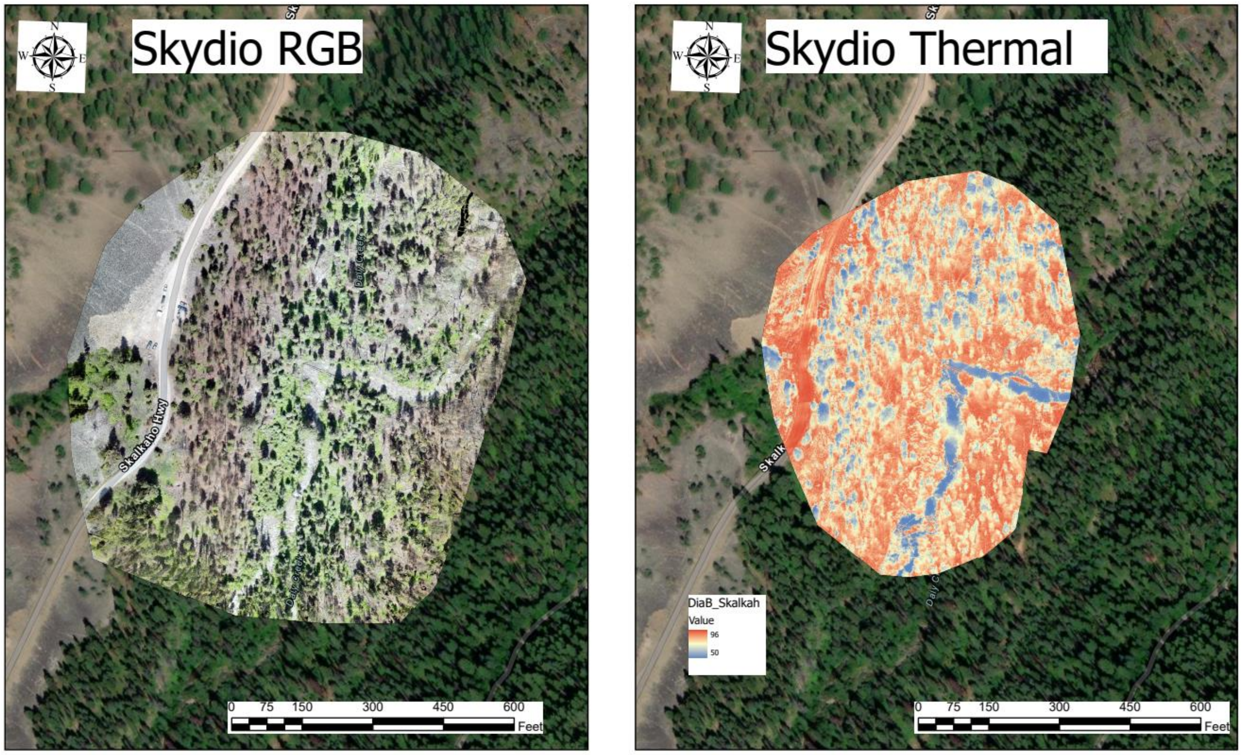


Figure 18. This Skydio orthomosaic and thermal mosaic were taken simultaneously at the Skalkaho site.

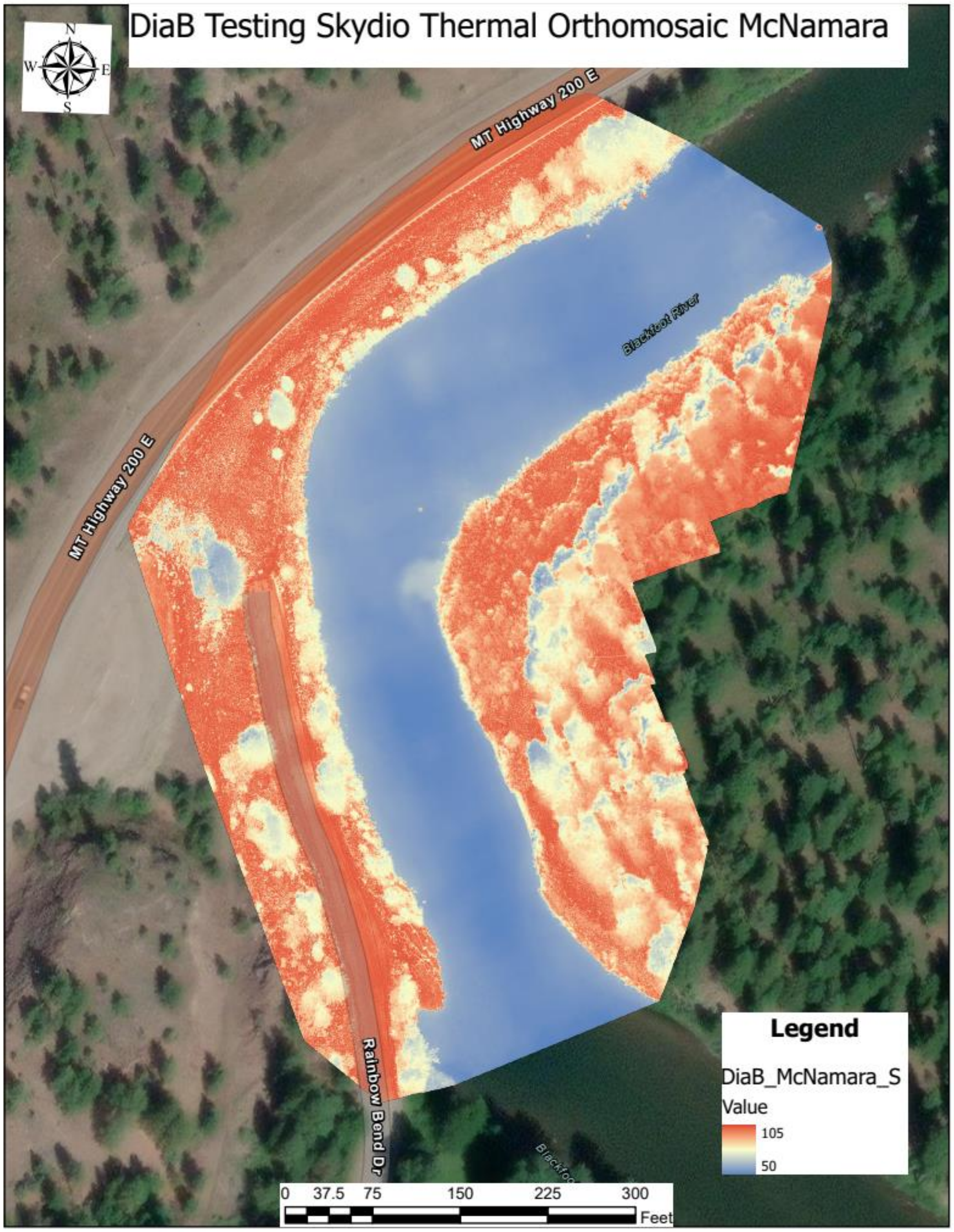


Figure 19. A Skydio thermal mosaic of the Blackfoot River in McNamara.