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A Method for Evaluating Automatic Identification System (AIS) Coverage on Select Inland Waterways in 2020 and 2021

Upper Mississippi River, Illinois River, and Ohio River

Marin M. Kress, Patricia K. DiJoseph, Morgan M. Johnston,
Brian J. Tetreault, James T. Kilroy, Brady A. Towne, Andrew Smith,
David Sathiaraj, and Andy Van Pelt

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Abstract

The Automatic Identification System (AIS) shares vessel position information for navigational safety purposes. AIS broadcasts are received by other ships and terrestrial stations; however, in some areas there is no, or low, terrestrial station coverage to receive broadcasts. The US Army Corps of Engineers (USACE) developed an Online Travel Time Atlas (OTTA) to process AIS data and derive a transit count. This study examined OTTA output from 2020 and 2021 to identify areas of high or low AIS coverage along the Upper Mississippi, Illinois, and Ohio Rivers. Segments with a yearly average of two or more transit per day were classified as high coverage, those with less than a yearly average of two transits per day were classified as low coverage. Rivers were segmented using the USACE National Channel Framework reach boundaries. Results based on calculated vessel transits were as follows: Upper Mississippi River: 837.4 miles (98%) had high coverage, with 17.4 miles (2%) of low coverage; Illinois River: 190.5 miles (59%) had high AIS coverage, and 133 miles (41%) had low AIS coverage; Ohio River: 644 miles (66%) had high coverage, and 337 miles (34%) had low coverage. AIS coverage could be improved by raising antennae heights, installing repeater equipment, or adding towers.

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Preface

This study was conducted for the US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC-CHL), Navigation Systems Research Program, under the Port Performance and Resiliency Work Unit; Funding Account Code U4381091; AMSCO Code 500954. The technical monitor was Ms. Morgan M. Johnston (CHL-Navigation Branch).

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The commander of ERDC was COL Christian Patterson and the director was Dr. David W. Pittman.

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1 Introduction

Automatic Identification System (AIS) broadcasts from vessels serve an important role in real-time maritime domain awareness and in historical examination of waterway usage. In the United States, AIS broadcasts are received at stations maintained by the US Coast Guard (USCG) (covering most coastal areas and some inland locations) and the US Army Corps of Engineers (USACE) (at inland locations, primarily at lock and dam structures). There are gaps in receiver coverage along the inland system, but these have not been systematically cataloged in a way that would allow AIS data users to know, in advance, if they should expect to have vessel position information available for a span of river. This report provides such a catalog for the Upper Mississippi River (UMR), the Illinois River, and the Ohio River using data from calendar years (CYs) 2020 and 2021. These waterways carry millions of tons of vital commodities every year (Table 1) and safe navigation is always a priority.

Table 1. Waterway tonnage and top commodity groups, Calendar Year (CY) 2020.

Waterway	CY2020 Tonnage	Top Commodity Groups by Tonnage
Mississippi River, Minneapolis, MN, to Mouth of Ohio River (WATERWAY)	111,485,314	Oilseeds (24,807,083) Corn (22,205,070) Sand, Gravel, Stone, Rock, Limestone, Soil, Dredged Material (17,710,606)
Illinois River, IL (WATERWAY)	28,644,586	Corn (6,211,602) Oilseeds (5,028,049) Chemicals and Related Products (2,863,224)
Ohio River (WATERWAY)	151,672,665	Coal, Lignite and Coal Coke (49,348,343) Crude Petroleum (3,828,372) Gasoline, Jet Fuel, Kerosene (6,707,872)

Source: USACE-WCSC, n.d. (<https://ndc.ops.usace.army.mil/wcsc/webpub/#/>)

1.1 Background

USACE maintains navigability for thousands of miles of navigation channels. The navigation mission is active in 41 US states and spans nearly 25,000 mi*

* For a full list of the spelled-out forms of the units of measure and unit conversions used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248–52 and 345–347, respectively. <https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf>.

of channels and 191 lock and dam sites (USACE-HQ, n.d.). AIS data provide a unique element of maritime domain awareness in the form of time-stamped and georeferenced vessel-movement data across coastal and inland areas and informs USACE waterway operations activities. Waterway operations supported by AIS data vary but may include real-time activities such as lock operations and lock queue management; rapid investigations of reported vessel groundings, which may require the deployment of hydrosurvey teams; and long-term studies of vessel movements to inform dredging requirements, navigation structure upgrades, or channel designs (Kress 2022; Kruse et al. 2022; Mitchell and Scully 2014; Tabbert et al. 2020; Young and Scully 2018).

AIS data, georeferenced and time-stamped data, are a valuable source of vessel movement information; however, historical data are not uniformly available across all waterways that carry commercial traffic within the USACE navigation mission space. The USCG maintains AIS towers in coastal and some inland sites, but the majority of the shore sites that make up the inland AIS network were developed and installed by research staff at the US Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), in concert with local USACE district staff. Additional vessel-mounted sites exist on 10 USACE-owned floating plant, including the Mat Sinking Unit, which works on the Lower Mississippi River (USACE-MVK, n.d.). These vessel-mounted sites act as mobile towers, able to receive AIS data and transmit it to the USACE-owned Lock Operations Management Application (LOMA) network as well as transmit data to other vessels via AIS. However, the presence of vessel-mounted systems can skew coverage records because they may temporarily provide reception in high-traffic areas that are normally out of range of shore sites. Because of this potentially confounding factor, the Lower Mississippi River was considered in this study, but the results are not included in this report.

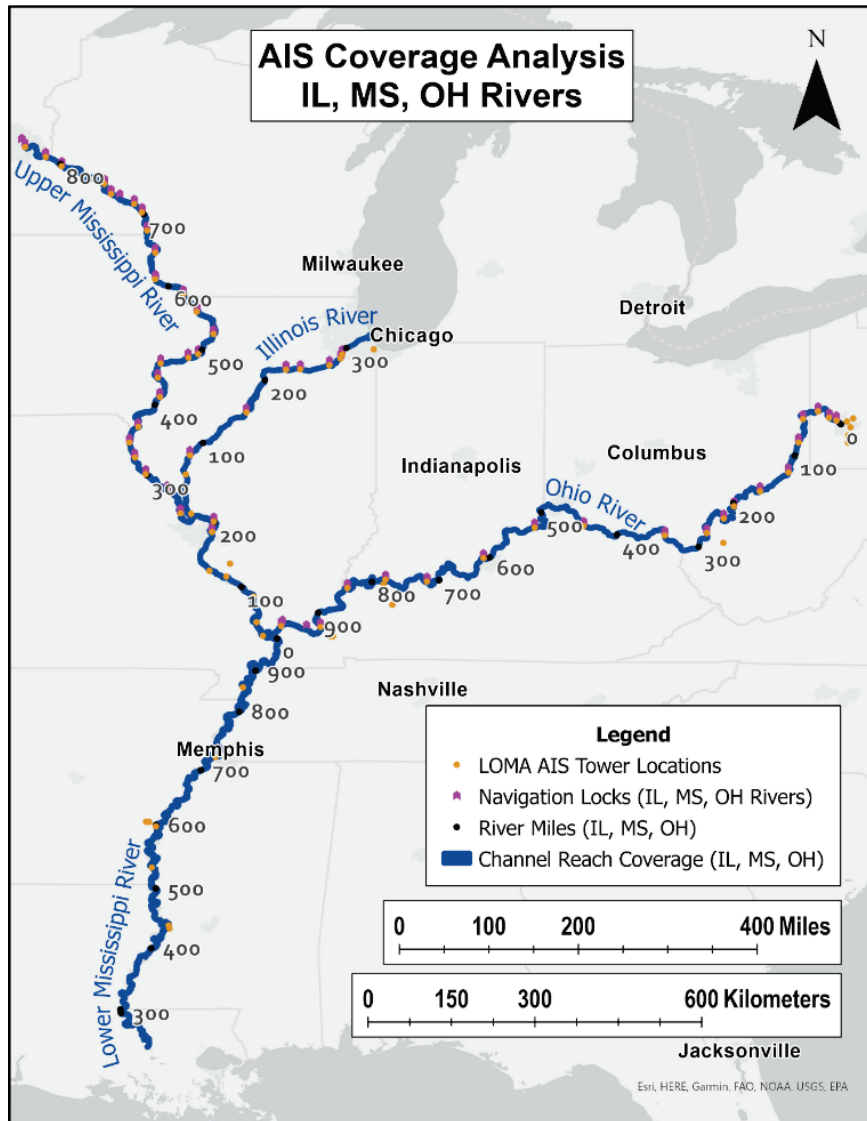
This project examining AIS signal coverage was carried out due to the wide variety of existing AIS data uses and the growing number of requests for historical AIS data from field practitioners, along with the known—but not uniformly documented—coverage gaps. As mentioned above, USACE district staff regularly use AIS data to investigate reports of vessel groundings on the channel bottom and as part of accident investigations. It is beneficial to examine the AIS terrestrial coverage network maintained by USACE for the following reasons: to establish a range of normal values for traffic or expected signal density; to identify changes in coverage that

might indicate equipment malfunction; and to identify coverage gaps so that future users of the data know where they can or cannot expect to have usable information.

1.2 Objective

The objective of this study was to provide an estimate of historic AIS data availability for the UMR, the Illinois River, and the Ohio River, using data from CY2020 and CY2021. Figure 1 shows the extent of the respective rivers included in this analysis.

Figure 1. Automatic Identification System (AIS) coverage analysis areas along the Illinois River, Ohio River, and the Upper Mississippi River (UMR). The Lower Mississippi River (LMR) was examined, but the majority of the river was not included in final results due to potentially confounding factors.



1.3 Approach

This study was executed by analyzing historic AIS data from the UMR, the Illinois River, and the Ohio River in CY2020 and CY2021. Individual AIS vessel-position reports were transformed into upbound or downbound transit counts per waterway reach (a geospatially referenced polygon). Waterway reaches were then classified as high coverage (yearly average more than two transits per day) or low coverage (yearly average fewer than two transits per day). Winter seasonal closures were also considered during this classification exercise.

2 Automatic Identification System (AIS) Data and The Lock Operations Management Application (LOMA) Network

2.1 AIS Data

The AIS “is a maritime navigation safety communications system standardized by the International Telecommunication Union (ITU) and adopted by the International Maritime Organization (IMO) that provides vessel information, including the vessel's identity, type, position, course, speed, navigational status and other safety-related information automatically to appropriately equipped shore stations, other vessels, and aircraft; receives automatically such information from similarly fitted ships; monitors and tracks ships; and exchanges data with shore-based facilities” as described in 33 CFR §164.46(a) (US Code of Regulations 2019; USCG, n.d.). Although AIS is primarily designed for collision avoidance, it also improves maritime domain awareness and provides identification and position of vessels in a way that is not always possible through voice radio or radar alone (USCG, n.d.). All AIS devices must be operated with an official nine-digit Maritime Mobile Service Identity (MMSI) number assigned to the vessel and its owner by the Federal Communication Commission (FCC) (USCG, n.d.).

Since 2016, AIS Class A carriage requirements include most commercial self-propelled vessels on US navigable waterways including the following:

- commercial vessels over 65 ft in length
- towing vessels over 26 ft in length and more than 600 hp
- vessels certified to carry 150 or more passengers
- passenger vessels that are 65 ft or more and certificated to carry fewer than 150 passengers but operate in a Vessel Traffic Service area or at speeds in excess of 14 kn
- dredges in or near a commercial channel
- vessels moving certain dangerous cargo, or flammable or combustible liquid cargo in bulk (USCG 2018; US Code of Regulations 2019)

AIS technical standards and history can be found online through international associations involved in setting technical standards (IALA 2008; IEC 2001; ITU- 2014; PIANC 2019).

In addition, the following vessels are required to install and use at least a Class B AIS transponder:

- commercial fishing vessels that are 65 ft or more in length
- commercial passenger vessels that are 65 ft or more and are certificated to carry fewer than 150 passengers but do not operate in a Vessel Traffic Service area or at speeds in excess of 14 kn
- dredges operating outside shipping fairways

AIS operates using the very high frequency (VHF) radio spectrum, operating on 161.975 MHz and 162.025 MHz. VHF transmissions are generally line-of-sight (i.e., the antenna of the transmitting station must have an unobstructed path to the receiving station's antenna). The transmission may be attenuated or blocked by the earth (radio horizon based on antenna heights or terrain) or structures. The signal may also be reduced by other factors such as transmission power, equipment condition, and quality of installation. Therefore, not all AIS signals transmitted by vessels are received by shore AIS stations and vice versa. Vessels transmit AIS position reports depending on their dynamic condition; the frequency varies from 2 s up to 3 min (Table 2) (ITU-R 2014; Tetreault et al. 2022). Vessel AIS stations can transmit other types of messages, but this study focused on position reports transmitted by vessels and received by terrestrial AIS stations along portions of the US inland waterway system.

Table 2. Class A shipborne mobile equipment reporting intervals.

Ship's Dynamic Conditions	Nominal Reporting Interval
Ship at anchor or moored and not moving faster than 3 kn	3 min
Ship at anchor or moored and moving faster than 3 kn	10 s
Ship 0: 14 kn	10 s
Ship 0: 14 kn and changing course	3 1/3 s
Ship 14: 23 kn	6 s
Ship 14: 23 kn and changing course	2 s
Ship >23 kn	2 s

Source: ITU-R M.1371-5 (2014, page 8)

2.2 The LOMA Network

The USACE LOMA system provides primary AIS coverage on inland waterways. AIS messages received by LOMA AIS shore sites are routed to the USCG where they are archived with other signals received by

Nationwide Automated Identification System for long-term storage. The LOMA program operates over 150 AIS transceivers located primarily along the inland waterways of the United States. Most LOMA transceivers are located at lock and dam facilities owned by USACE (hence the original program name and acronym), but transceivers can be installed in other locations. For example, AIS receivers have been successfully installed at the Applied River Engineering Center in USACE St. Louis District, on a state-owned bridge over the Mississippi River at Vicksburg, Mississippi, and on board multiple USACE-owned vessels. At the time of this study, the USACE-owned vessels with LOMA transceiver equipment were operating only within the USACE Mississippi Valley Division boundaries.

AIS transceivers receive transmissions from AIS-equipped vessels transiting these waters and transmit information to vessels to be used for safe navigation, including AIS Aids to Navigation (Tetreault et al. 2022). The antennae heights for AIS stations vary across the inland system due to the availability of installation location options; some antennae are located relatively low to the ground (e.g., on the roof of a lock house [approximately 10 m high]) while others are much higher. The highest antenna in the LOMA system is located at the Glasgow site on the Missouri River at 123.4 m high. The Glasgow site can receive signals from approximately 150 mi of river due to a combination of factors including height and local terrain (Tetreault et al. 2022). Raising an AIS antennae height has been shown to improve signal reception at another site on the Missouri River (Tetreault et al. 2022). This is known to be a simple and low-cost way to improve signal reception.

The LOMA network of AIS towers is continually evolving, and coverage is known to have changed over the past decade. Therefore, the results of the current coverage analysis based on 2020 and 2021 data may not be totally applicable to previous years. In addition, future expansions or equipment upgrades will continue to affect coverage results. For example, there are ongoing discussions (as of Fiscal Year [FY] 2323) between the LOMA team and the USACE New Orleans District to deploy multiple new sites in the near term. The LOMA technical team continues to evaluate other possible AIS sites, such as on bridges crossing the Ohio River, many of which are owned by state departments of transportation and thus require additional coordination. In addition to the AIS sites owned by USACE, other entities can install their own AIS signal reception equipment; however, those installations are not included in this project.

3 Method

3.1 National Channel Framework (NCF)

The expansive system of federal navigation projects has been geospatially referenced and divided into unique polygons within the National Channel Framework (NCF) (USACE 2021). Each USACE district is responsible for creating and maintaining the portion of the NCF corresponding to reaches within its district; this applies for both coastal and inland areas. Inland waterways include the UMR, Lower Mississippi River, Ohio River, Cumberland River, Tennessee River, Arkansas River, and Illinois River (not all are examined in this report). Each NCF reach has a unique identifier (e.g., CEMVP_UM_SP_P05_5, which spans River Mile (RM) 752 to 750 on the UMR). In some places with islands dividing a waterway, there are separate reaches (polygons) on each side of the island; often only one route will be used for commercial navigation. This project included 425 reaches along the UMR, 246 reaches along the Illinois River, and 521 reaches along the Ohio River.

3.2 Receiving and Parsing AIS Data

An existing USACE product, the Online Travel Time Atlas (OTTA), receives AIS data and uses them to calculate travel time for different segments of the inland waterway system. The OTTA was used in this project because it already had an established process for receiving AIS data, parsing it, and storing it in relation to the NCF. In brief, the OTTA receives AIS data sent via a live LOMA feed, and any messages with incomplete timestamps or coordinates are discarded. A Python script is used to extract a subset of messages from the AIS broadcasts from moving vessels (messages 1, 2, 3, 5, 18, and 27), which are then grouped by MMSI, and downsampled to 2 min increments (taking the last message from each 2 min group). Then, the coordinates from each remaining AIS position report are used to join that record to the closest channel reach polygon (where available). This joining is important to be able to later provide fast travel-time calculations. After this step, the resulting data exist in a JSON format, and it is inserted into a MongoDB database (MongoDB, Inc. 2023) along with the channel reach polygon information.

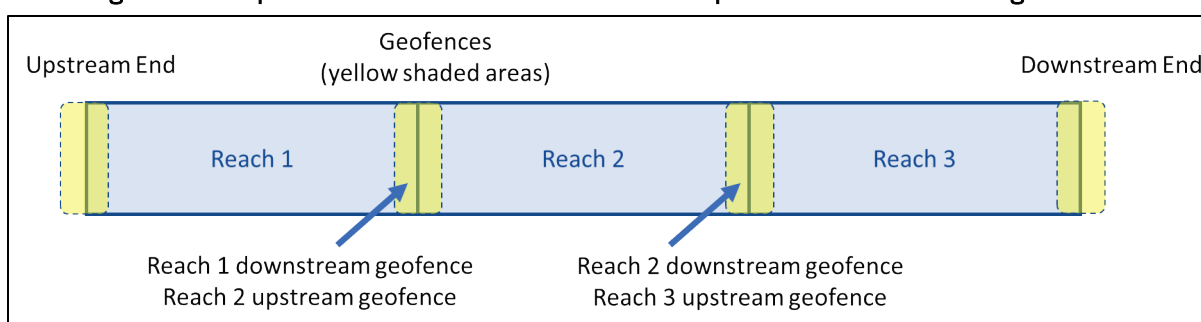
An important caveat applies to the reception of AIS data by the OTTA: there are times when the data feed has stopped functioning due to various

technical challenges. However, it is possible to backfill data from other caches of the AIS broadcasts, and this has been done to fully populate the OTTA records. During 2020 and 2021, the average raw number of AIS messages received per day was 170,327,180. After filtering at 2 min intervals, the number of stored records was reduced to 2,853,836 per day. From 1 April 2021 to 9 December 2021, there were only 22 days with zero messages initially received by the OTTA database.

3.3 Calculating Vessel Transits and Transit Statistics per Channel Reach

Each channel reach along the inland system has an upstream end and a downstream end; these are used to orient the AIS position reports in a direction of travel. For the OTTA, each reach has a geofenced area approximately 0.4 mi long at the upstream reach and another at the downstream reach. The geofence is centered on the border between the neighboring channel reach such that half of the geofence is in the current reach and half is in the immediate upstream or downstream reach. An upbound trip for a single reach is defined as a vessel traveling from the downstream geofence to the upstream geofence, and a downbound trip for a reach is defined as traveling from the reach's upstream geofence to the reach's downstream geofence. Thus, a vessel needs to travel from one end of the reach to the other for a transit to be included in the OTTA statistics. An example schematic of the channel reaches and geofences is shown in Figure 2.

Figure 2. Example of channel framework reaches with upstream and downstream geofences.



The transit time for an upstream transit in a reach is defined as the difference in the time stamps of the last AIS data point in the reach's downstream geofence and the first AIS data point in the reach's upstream geofence. Likewise, the transit time for a downstream transit in a reach is defined as the difference in the time stamps of the last AIS data point in

the reach's upstream geofence and the first AIS data point in the reach's downstream geofence.

For each day and each reach, all vessels in a given reach are identified by their MMSI number. Then, for each vessel, any possible trips through that specific channel reach are tabulated and added to an overall list of upstream and downstream voyages for that day. Once all vessel voyages have been tabulated, daily statistics are calculated by direction of travel, including the average travel time, 25th, 75th, 95th percentiles, minimum and maximum travel times, and overall count of transits. The statistical processing is done via a Python script, and the daily results are stored in another MongoDB database table. Overall travel times, from one reach on the river to another, are then calculated using the sum of averages for each reach along the route. The coverage analysis project used the existing count of upbound and downbound transits at each reach that were readily available within the OTTA database for 2020 and 2021.

3.4 Winter Ice Seasons on the Upper Mississippi River (UMR)

Seasonal waterway closures due to ice are an important consideration on the UMR; they also impact the expected number of total transits per reach. The start and end of winter ice season varies each year, but for the 2019–2020 winter, it started in late 2019 and extended through 5 April 2020 (Kennedy 2020). To avoid the appearance of low coverage as the result of these winter closures, the study period for the UMR was shortened to only include the time of year when the waterway was open. The year 2020 transit counts for this waterway spanned from 6 April 2020 through 30 November 2020. The winter 2020–2021 ice season started on 1 December 2020 and extended through 19 March 2021 (Kennedy 2020; USACE-MVP 2021). The winter 2021–2022 ice season started on 24 November 2021 (USACE-MVP 2021). The year 2021 transit counts were examined only from 19 March 2021–23 November 2021 for the UMR. Although the start of ice season does not result in immediate closure of the entire UMR, for the sake of consistency, transit counts for the entire UMR were pulled only for the date ranges as described. Although ice is a navigation hazard on the Illinois Waterway and Ohio River and can temporarily stop vessel traffic, there is no annual main stem closure in the same way as the Upper Mississippi; efforts to reduce the impacts of ice on the Ohio and Illinois Rivers main stem navigability have been under investigation for decades (Perham 1988).

3.5 Assignment as Low- or High-Coverage Reach

Based on the AIS data acquisition and calculation method described above, the AIS coverage level for each waterway reach was categorized as either low or high. Low coverage was defined as having fewer than an annual average of two transits per day. High coverage was defined as having an average of two or more transits recorded per day across the year. The appendix includes the observed transit counts for upbound and downbound transits per reach in 2020 and 2021. These transit counts can be applied for considering additional coverage assignment methods for future studies. Due to geoprocessing limitations (described in Section 4), a minimal number of reaches that were identified as low coverage were later manually assigned as high coverage.

The use of two transits per day as the dividing line between high and low coverage should be considered as one of multiple possible approaches, not as the definitive metric by which all AIS coverage should be measured. For example, one possible method could compare AIS signal reception against known vessel transits (available from other USACE data sources) but would require reconciliation of AIS vessel names against vessel names as recorded by human observers. Another alternate approach to coverage analysis could use simple counts of AIS signal density at the reach level as the unit of measure (this is the process used to make heatmaps). This method was considered but would have required data storage beyond what was readily available. In addition, cut-off points for low coverage areas would still need to be set. The original AIS signals are not permanently stored by the OTTA system, so the use of transit counts—a product derived from AIS data—was identified as both feasible at present and accessible in future if this type of analysis is repeated.

4 AIS Coverage Results

This section contains the AIS coverage analysis results based on data from 2020 and 2021. Tabular summaries and map visualizations with color-coded river sections based on high- or low-coverage level for each river are presented.

4.1 Ongoing LOMA Network Changes

The LOMA network was initially installed at USACE facilities with existing electrical power and network connections starting in 2010. However, over the years as awareness of AIS data and potential applications has grown, more sites have come online as funding and installation locations have been established. For example, multiple AIS stations were installed in St. Louis District in the spring and fall of 2019. LOMA network changes, including movements of vessel-mounted mobile towers up and down the Mississippi River, occurred during 2020 and 2021 (years examined in this report). The initial coverage analysis showed a significant change in two large swaths of the LMR, but because of the potential confounding factor of temporary coverage (from nonstationary vessel-mounted or trailer-mounted systems operating in the area) the majority of LMR was excluded from the final results. It is mentioned here as a point of interest for those using AIS data from that area and for awareness to anyone conducting their own historical traffic or coverage analysis. Note that the river-mile numbering scheme on the LMR is not contiguous with the UMR. In the LMR, the river-mile notation counts upward from RM 0 at the river mouth in the Gulf of Mexico and increases with movement north (upriver).

One area on the UMR that saw a notable increase in coverage from 2020 to 2021 was RMs 30–95 around Cape Girardeau. This was known to be the result of St. Louis District installing remote solar-powered AIS stations to fill in the known coverage gap downstream from the St. Louis metropolitan area. The USACE St. Louis District had previously installed supplemental AIS stations, but the new equipment that improved the reception around Cape Girardeau was installed 26 February 2020.

An area on the LMR that saw an improvement in AIS signal reception from 2020 to 2021 was the stretch of RMs 490–570. On 10 February 2020, the LOMA team gained access to an existing AIS station (originally installed by the state) located on the Greenville bridge that spans the LMR between

Greenville, Mississippi, and Lake Village, Arkansas. New AIS equipment was installed on 12 July 2020 to allow that site to join the LOMA network.

4.2 AIS coverage summaries: UMR, Illinois River, and Ohio River

This section presents tabular results for the UMR, Illinois River, and Ohio River. Adjacent reaches that had the same level of qualitative coverage designation (high or low) are presented together in a single row of the table along with the river-mile endpoints and the starting and ending alphanumeric reach identification codes (reach ID).

4.2.1 UMR Summary

Of the 854.8 river miles along the UMR included in this analysis, 837.4 mi (98%) had high coverage while 17.4 mi (2%) had low coverage in 2021. Table 3 presents the details of where the high-coverage and low-coverage segments of the river start and stop based on their NCF reach ID. Figure 3 presents a map of coverage for the UMR. Detailed maps of coverage levels for the UMR reaches begin with Figure 4.

Table 3. AIS Coverage Summary: UMR, 2021.

RM Start	RM End	RM Length	UMR Reach ID Start	Reach ID End	2021 Coverage Qualitative Category
0	194	194	CEMVS_UM_SL_EPC_1	CEMVS_UM_SL_MRC_3	High
184	198	14	CEMVS_UM_SL_MRC_1	CEMVS_UM_SL_MRC_1	High ^a
198	286	88	CEMVS_UM_SL_MRC_4	CEMVS_UM_SL_P24_1	High
286	302	16	CEMVS_UM_SL_P24_2	CEMVR_UM_22_MVR_24	High ^b
302	387	85	CEMVR_UM_22_MVR_23	CEMVR_UM_19_MVR_24	High
387	389	2	CEMVR_UM_19_MVR_23	CEMVR_UM_19_MVR_22	Low
389	525	136	CEMVR_UM_19_MVR_21	CEMVR_UM_13_MVR_32	High
527	528	1	CEMVR_UM_13_MVR_29	CEMVR_UM_13_MVR_29	High ^c
528	569	41	CEMVR_UM_13_MVR_28	CEMVR_UM_12_MVR_15	High
569	570	1	CEMVR_UM_12_MVR_14	CEMVR_UM_12_MVR_14	Low
570	776.2	206.2	CEMVR_UM_12_MVR_13	CEMVP_UM_SP_P04_7	High
776.2	786.2	10	CEMVP_UM_SP_P04_8	CEMVP_UM_SP_P04_9	Low

Table 3 (cont.). AIS Coverage Summary: UMR, 2021.

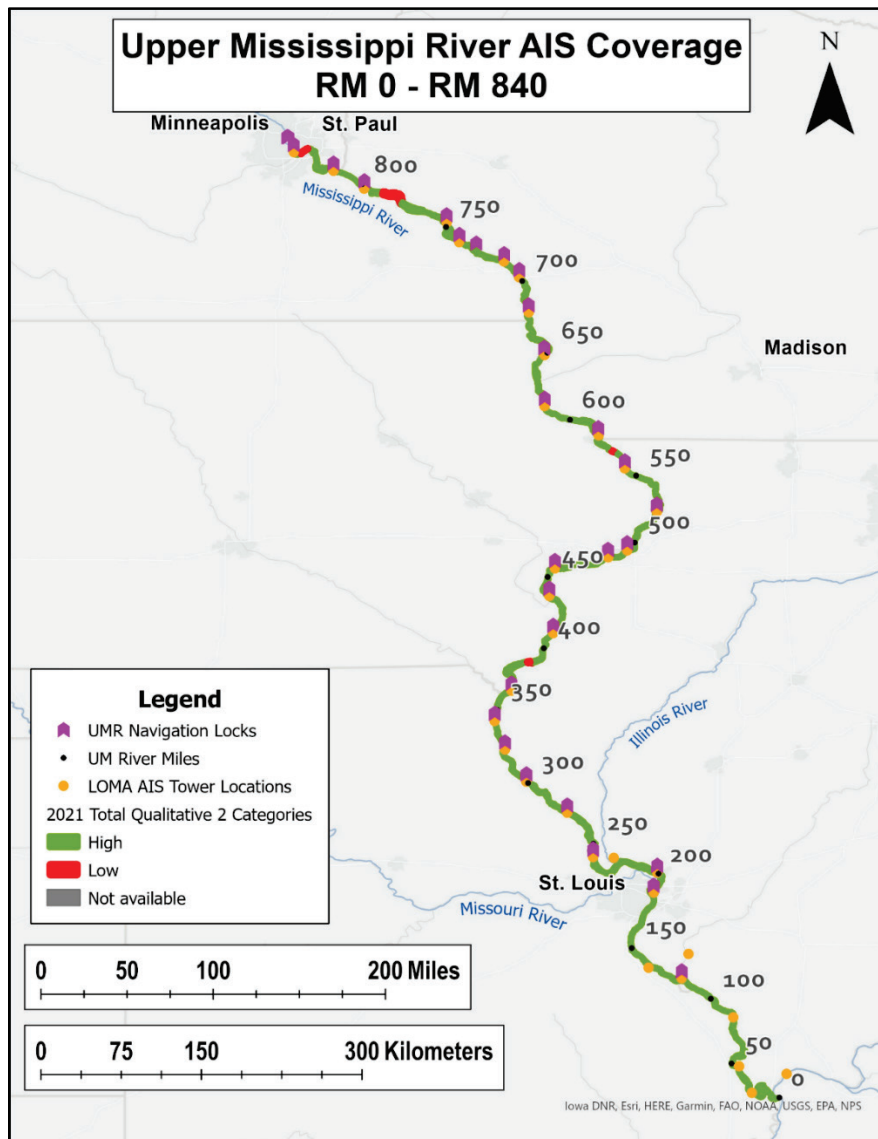
RM Start	RM End	RM Length	UMR Reach ID Start	Reach ID End	2021 Coverage Qualitative Category
786.2	839.1	52.9	CEMVP_UM_SP_P04_10	CEMVP_UM_SP_P02_6	High
839.1	843.5	4.4	CEMVP_UM_SP_P02_7	CEMVP_UM_SP_P02_7	Low
843.5	846.8	3.3	CEMVP_UM_SP_P02_8	CEMVP_UM_SP_P02_8	High

^a River traffic exits Mississippi River mainstem and uses Chain of Rocks Canal (Figure 20).

^b Manually assigned to high coverage category (Figure 21).

^c Manually assigned to high coverage category (Figure 22).

Figure 3. Automatic Identification System (AIS) coverage map, UMR, River Miles (RMs) 0–840.



4.2.2 UMR AIS Coverage Details

For the UMR, the percentage of reaches categorized as high coverage was 95% in 2020 and 98% in 2021. A total of 425 NCF reaches were included in this waterway, starting upstream at reach CEMVP_UM_SP_P02_8, located at UMR RM 846.8 in Minnesota, to reach CEMVS_UM_SL_EPC_1, which ends downstream at UMR RM 0 at the confluence of the UMR and the Ohio River near Cairo, Illinois. An overview of the low coverage (*red*) and high coverage (*green*) areas is shown in Figure 3.

Along the UMR, there were nine reaches originally categorized as low coverage in 2021; after manual correction, this number was reduced to six reaches, which equals 2% of the UMR included in the study (see Section 4.3 for full details). The reaches with low transit counts in 2021 are listed in Table 4, including those that were manually assigned to the high-coverage category. The Appendix provides calculated transit counts by direction and year for each reach. Consecutive reaches with low transit counts along the UMR, normally indicating a stretch of waterway with poor AIS coverage, are shown in Table 4.

Table 4. UMR Reaches with low transit counts, 2021.

USACE District	Upstream End of Reach, UMR RM	Downstream End of Reach, UMR RM	Reach Length (mi)	UMR Reaches with Low AIS Coverage	2021 Total Observed Transits (Upbound and Downbound)
St. Paul	843.5	839.1	4.4	CEMVP_UM_SP_P02_7	355
St. Paul	786.2	782.8	3.4	CEMVP_UM_SP_P04_9	428
St. Paul	782.8	776.2	6.6	CEMVP_UM_SP_P04_8	397
Rock Island	570	569	1	CEMVR_UM_12_MVR_14	455
Rock Island	528	527	1	CEMVR_UM_13_MVR_29 ^a	0 ^a
Rock Island	389	388	1	CEMVR_UM_19_MVR_22	363
Rock Island	388	387	1	CEMVR_UM_19_MVR_23	404
Rock Island	302	301.2	0.8	CEMVR_UM_22_MVR_24 ^a	0 ^a

Table 4 (cont.). UMR Reaches with low transit counts, 2021.

USACE District	Upstream End of Reach, UMR RM	Downstream End of Reach, UMR RM	Reach Length (mi)	UMR Reaches with Low AIS Coverage	2021 Total Observed Transits (Upbound and Downbound)
St. Louis	301.1	286	15.1	CEMVS_UM_SL_P24_2 ^a	0 ^a
St. Louis	198	184	14 ^b	CEMVS_UM_SL_MRC_1 ^c	253

^a Reach manually assigned to high coverage due to reaches overlapping across districts (see Section 4.3.2 for full explanation). Lock & Dam 22 is located at RM 301 and has functioning AIS transceiver equipment.

^b Only RMs 194–198 in this reach are used for commercial navigation. RMs 184–194 are bypassed using the Chain of Rocks canal (reach CEMVS_UM_MRC_3).

^c Reach manually assigned to high coverage; vessels transit only upper portion of the reach due to diverting to transit the Chain of Rocks canal (reach CEMVS_UM_MRC_3).

Moving from north to south, Figure 4 through Figure 9 present the AIS coverage analysis results for the UMR.

Figure 4. AIS coverage map, UMR, RM 720–840.

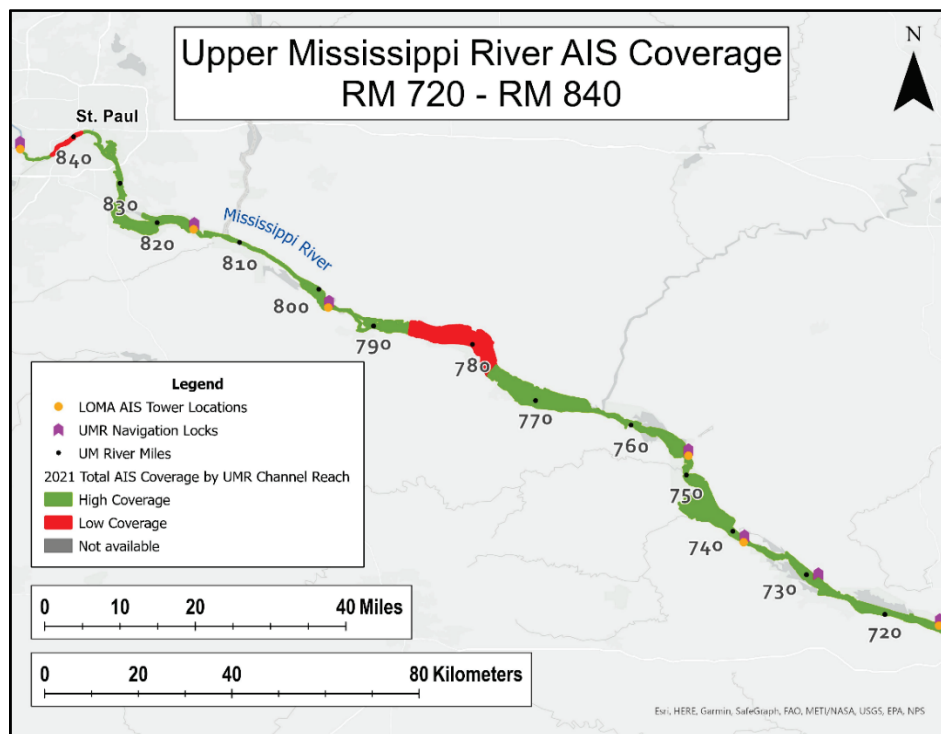


Figure 5. AIS coverage map, UMR, RMs 600–720.

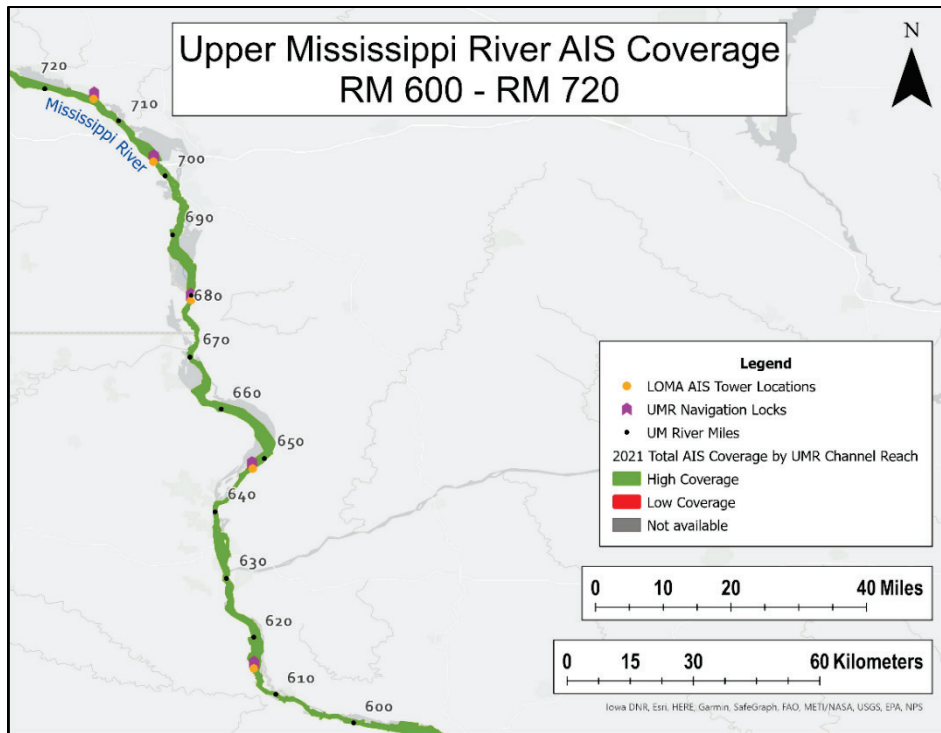


Figure 6. AIS coverage map, UMR, RMs 470–600.

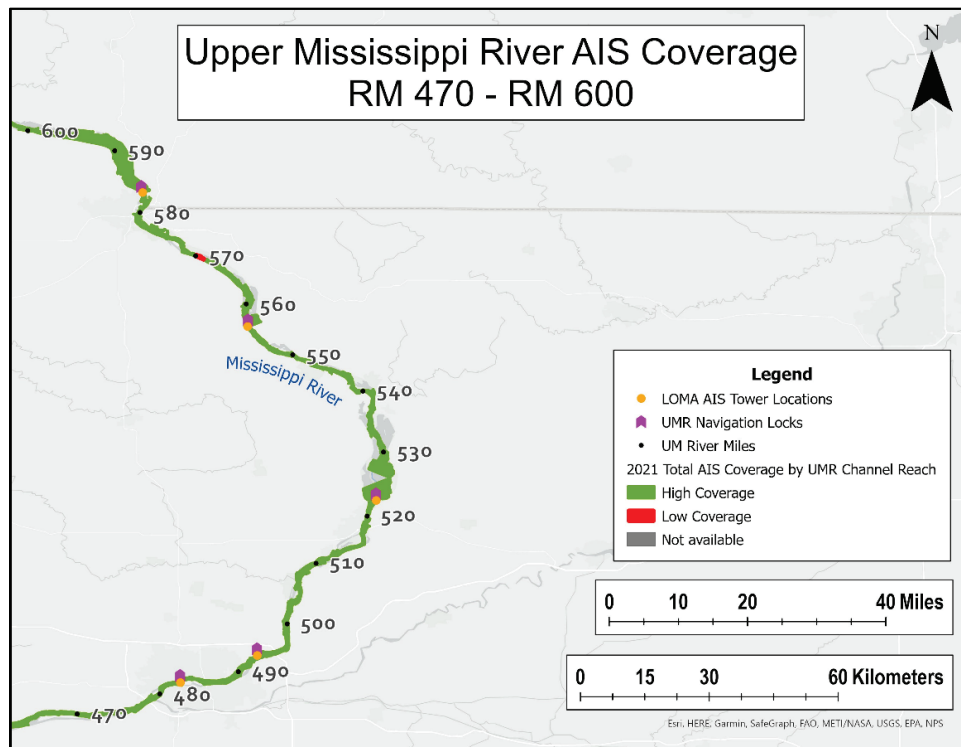


Figure 7. AIS coverage map, UMR, RMs 340-470.

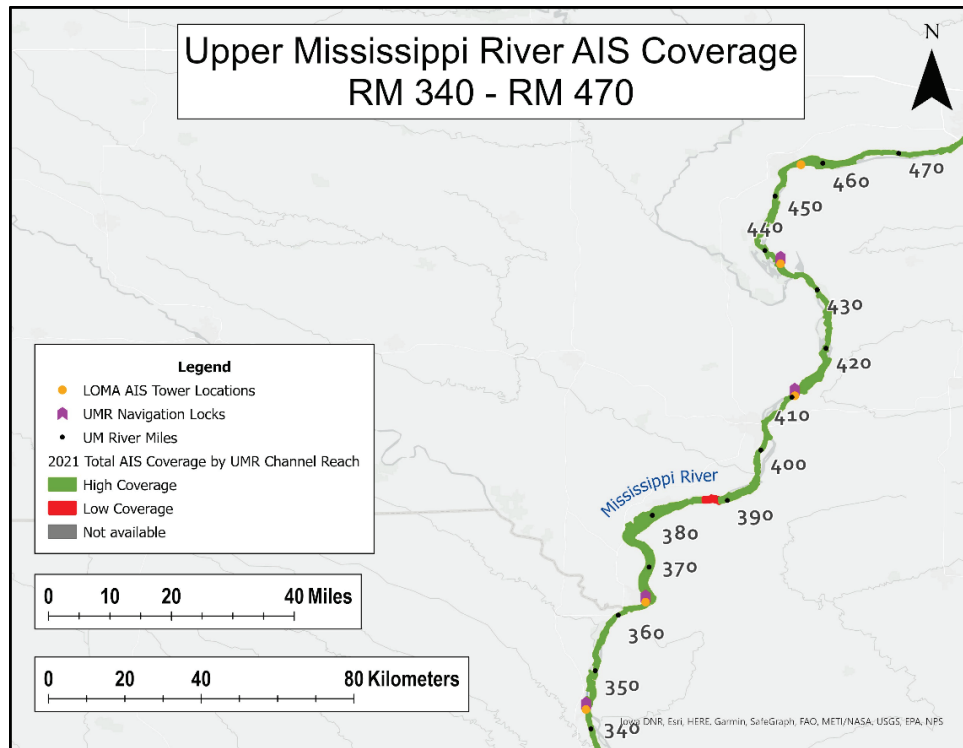


Figure 8. AIS coverage map, UMR, RMs 170-340.

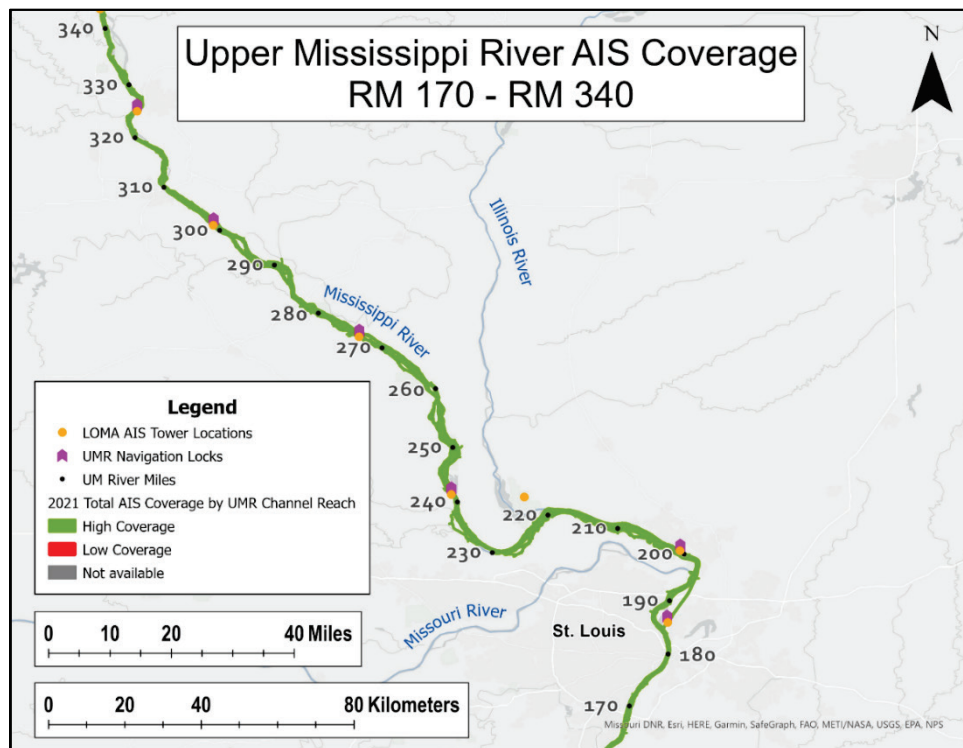
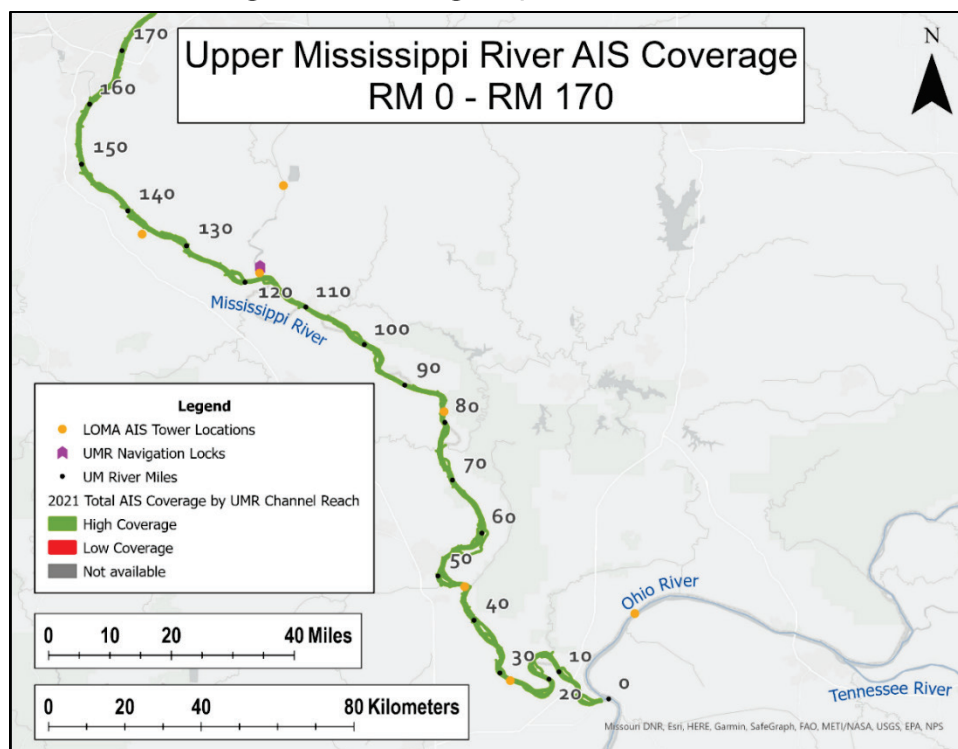


Figure 9. AIS coverage map, UMR, RMs 0-170.



4.2.3 Illinois River Summary

Of the 323.5 river miles of the Illinois River included in this analysis, 190.5 miles (59%) had high AIS coverage while 133 miles (41%) had low AIS coverage. Table 5 presents the details of where the high-coverage and low-coverage segments of the Illinois River start and stop based on their NCF reach ID and corresponding Illinois RM endpoints. Figure 10 presents a map of the coverage results for the Illinois River.

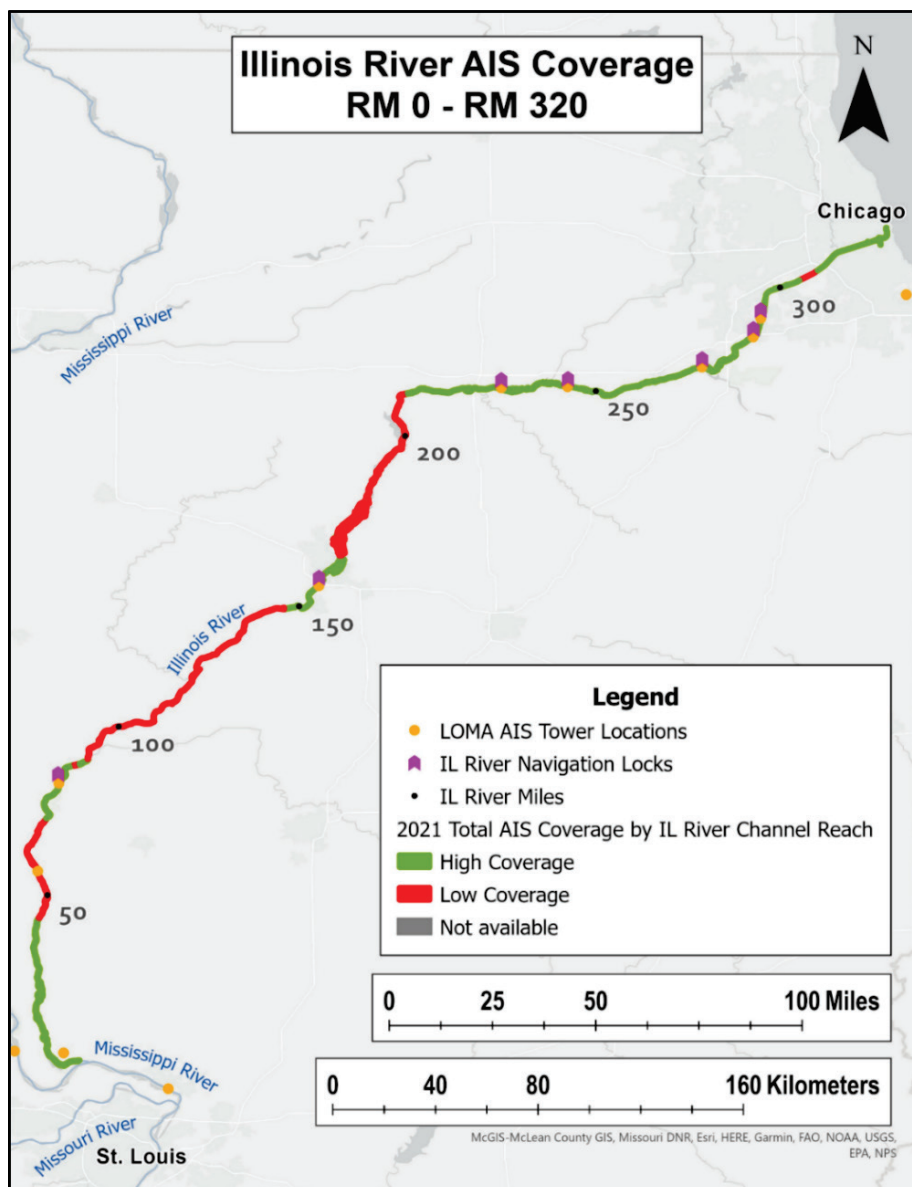
Table 5. AIS coverage summary, Illinois River, 2021.

RM Start	RM End	RM Length	Illinois River Reach ID Start	Illinois River Reach ID End	2021 Coverage Qualitative Category
2	44.1	42.1	CEMVS_IL_SL_IL1_1	CEMVS_IL_SL_IL2_2	High
44.1	70.1	26	CEMVS_IL_SL_IL2_3	CEMVS_IL_SL_IL2_3	Low
70.1	86	15.9	CEMVS_IL_SL_IL2_4	CEMVR_IL_LA_MVR_6	High
86	87	1	CEMVR_IL_LA_MVR_7	CEMVR_IL_LA_MVR_7	Low
87	89	2	CEMVR_IL_LA_MVR_8	CEMVR_IL_LA_MVR_9	High
89	147	58	CEMVR_IL_LA_MVR_10	CEMVR_IL_LA_MVR_67	Low
147	167	20	CEMVR_IL_LA_MVR_68	CEMVR_IL_PE_MVR_9	High

Table 5 (cont.). AIS coverage summary, Illinois River, 2021.

RM Start	RM End	RM Length	Illinois River Reach ID Start	Illinois River Reach ID End	2021 Coverage Qualitative Category
167	171	4	CEMVR_IL_PE_MVR_10	CEMVR_IL_PE_MVR_13	Low
171	172	1	CEMVR_IL_PE_MVR_14	CEMVR_IL_PE_MVR_14	High
172	212	40	CEMVR_IL_PE_MVR_15	CEMVR_IL_PE_MVR_54	Low
212	304	92	CEMVR_IL_PE_MVR_55	CEMVR_IL_LP_MVR_13	High
304	308	4	CEMVR_IL_LP_MVR_14	CEMVR_IL_LP_MVR_17	Low
308	325.5	17.5	CEMVR_IL_LP_MVR_18	CEMVR_IL_LP_MVR_34	High

Figure 10. AIS coverage map, Illinois River, RMs 0-320.



4.2.4 Illinois River AIS coverage details

The Illinois River reaches included in this study started at RM 320 near Chicago, Illinois, and continued to RM 0 at the confluence of the Illinois River and the UMR near Grafton, Illinois, and St. Charles County, Missouri, respectively. Figure 10 shows the extent of AIS coverage along the river from RM 0 to RM 320; Figure 11 through Figure 13 show AIS coverage in more detail for three sections of the river. Of the 323.5 river miles of the Illinois River included in this analysis, 190.5 miles (59%) had high AIS coverage, and 133 mi (41%) had low AIS coverage. Reaches on the Illinois River with low calculated transit counts based on data from 2021 are shown in Table 6.

Table 6. Illinois River reaches with low transit counts, 2021.

USACE District	Upstream End of Reach, Illinois River Mile	Downstream End of Reach, Illinois River Mile	Reach Length (mi)	Illinois River Reaches with Low AIS Coverage	2021 Total Observed Transits (Upbound and Downbound)
Rock Island	308	307	1	CEMVR_IL_LP_MVR_17	443
Rock Island	307	306	1	CEMVR_IL_LP_MVR_16	413
Rock Island	306	305	1	CEMVR_IL_LP_MVR_15	554
Rock Island	305	304	1	CEMVR_IL_LP_MVR_14	524
Rock Island	212	211	1	CEMVR_IL_PE_MVR_54	681
Rock Island	211	210	1	CEMVR_IL_PE_MVR_53	49
Rock Island	210	209	1	CEMVR_IL_PE_MVR_52	19
Rock Island	209	208	1	CEMVR_IL_PE_MVR_51	29
Rock Island	208	207	1	CEMVR_IL_PE_MVR_50	31
Rock Island	207	206	1	CEMVR_IL_PE_MVR_49	56
Rock Island	206	205	1	CEMVR_IL_PE_MVR_48	16
Rock Island	205	204	1	CEMVR_IL_PE_MVR_47	17
Rock Island	204	203	1	CEMVR_IL_PE_MVR_46	8
Rock Island	203	202	1	CEMVR_IL_PE_MVR_45	3
Rock Island	202	201	1	CEMVR_IL_PE_MVR_44	7
Rock Island	201	200	1	CEMVR_IL_PE_MVR_43	8
Rock Island	200	199	1	CEMVR_IL_PE_MVR_42	10
Rock Island	199	198	1	CEMVR_IL_PE_MVR_41	12
Rock Island	198	197	1	CEMVR_IL_PE_MVR_40	9
Rock Island	197	196	1	CEMVR_IL_PE_MVR_39	7
Rock Island	196	195	1	CEMVR_IL_PE_MVR_38	10
Rock Island	195	194	1	CEMVR_IL_PE_MVR_37	16

Table 6 (cont.). Illinois River reaches with low transit counts, 2021.

USACE District	Upstream End of Reach, Illinois River Mile	Downstream End of Reach, Illinois River Mile	Reach Length (mi)	Illinois River Reaches with Low AIS Coverage	2021 Total Observed Transits (Upbound and Downbound)
Rock Island	194	193	1	CEMVR_IL_PE_MVR_36	19
Rock Island	193	192	1	CEMVR_IL_PE_MVR_35	28
Rock Island	192	191	1	CEMVR_IL_PE_MVR_34	30
Rock Island	191	190	1	CEMVR_IL_PE_MVR_33	25
Rock Island	190	189	1	CEMVR_IL_PE_MVR_32	24
Rock Island	189	188	1	CEMVR_IL_PE_MVR_31	34
Rock Island	188	187	1	CEMVR_IL_PE_MVR_30	18
Rock Island	187	186	1	CEMVR_IL_PE_MVR_29	14
Rock Island	186	185	1	CEMVR_IL_PE_MVR_28	20
Rock Island	185	184	1	CEMVR_IL_PE_MVR_27	12
Rock Island	184	183	1	CEMVR_IL_PE_MVR_26	8
Rock Island	183	182	1	CEMVR_IL_PE_MVR_25	10
Rock Island	182	181	1	CEMVR_IL_PE_MVR_24	13
Rock Island	181	180	1	CEMVR_IL_PE_MVR_23	14
Rock Island	180	179	1	CEMVR_IL_PE_MVR_22	30
Rock Island	179	178	1	CEMVR_IL_PE_MVR_21	60
Rock Island	178	177	1	CEMVR_IL_PE_MVR_20	44
Rock Island	177	176	1	CEMVR_IL_PE_MVR_19	44
Rock Island	176	175	1	CEMVR_IL_PE_MVR_18	106
Rock Island	175	174	1	CEMVR_IL_PE_MVR_17	224
Rock Island	174	173	1	CEMVR_IL_PE_MVR_16	299
Rock Island	173	172	1	CEMVR_IL_PE_MVR_15	671
Rock Island	171	170	1	CEMVR_IL_PE_MVR_13	522
Rock Island	170	169	1	CEMVR_IL_PE_MVR_12	449
Rock Island	169	168	1	CEMVR_IL_PE_MVR_11	142
Rock Island	168	167	1	CEMVR_IL_PE_MVR_10	155
Rock Island	147	146	1	CEMVR_IL_LA_MVR_67	509
Rock Island	146	145	1	CEMVR_IL_LA_MVR_66	385
Rock Island	145	144	1	CEMVR_IL_LA_MVR_65	702
Rock Island	144	143	1	CEMVR_IL_LA_MVR_64	237
Rock Island	143	142	1	CEMVR_IL_LA_MVR_63	133
Rock Island	142	141	1	CEMVR_IL_LA_MVR_62	119
Rock Island	141	140	1	CEMVR_IL_LA_MVR_61	147
Rock Island	140	139	1	CEMVR_IL_LA_MVR_60	60
Rock Island	139	138	1	CEMVR_IL_LA_MVR_59	56

Table 6 (cont.). Illinois River reaches with low transit counts, 2021.

USACE District	Upstream End of Reach, Illinois River Mile	Downstream End of Reach, Illinois River Mile	Reach Length (mi)	Illinois River Reaches with Low AIS Coverage	2021 Total Observed Transits (Upbound and Downbound)
Rock Island	138	137	1	CEMVR_IL_LA_MVR_58	114
Rock Island	137	136	1	CEMVR_IL_LA_MVR_57	183
Rock Island	136	135	1	CEMVR_IL_LA_MVR_56	450
Rock Island	135	134	1	CEMVR_IL_LA_MVR_55	435
Rock Island	134	133	1	CEMVR_IL_LA_MVR_54	55
Rock Island	133	132	1	CEMVR_IL_LA_MVR_53	42
Rock Island	132	131	1	CEMVR_IL_LA_MVR_52	117
Rock Island	131	130	1	CEMVR_IL_LA_MVR_51	103
Rock Island	130	129	1	CEMVR_IL_LA_MVR_50	58
Rock Island	129	128	1	CEMVR_IL_LA_MVR_49	51
Rock Island	128	127	1	CEMVR_IL_LA_MVR_48	43
Rock Island	127	126	1	CEMVR_IL_LA_MVR_47	52
Rock Island	126	125	1	CEMVR_IL_LA_MVR_46	55
Rock Island	125	124	1	CEMVR_IL_LA_MVR_45	90
Rock Island	124	123	1	CEMVR_IL_LA_MVR_44	82
Rock Island	123	122	1	CEMVR_IL_LA_MVR_43	56
Rock Island	122	121	1	CEMVR_IL_LA_MVR_42	58
Rock Island	121	120	1	CEMVR_IL_LA_MVR_41	48
Rock Island	120	119	1	CEMVR_IL_LA_MVR_40	96
Rock Island	119	118	1	CEMVR_IL_LA_MVR_39	62
Rock Island	118	117	1	CEMVR_IL_LA_MVR_38	50
Rock Island	117	116	1	CEMVR_IL_LA_MVR_37	74
Rock Island	116	115	1	CEMVR_IL_LA_MVR_36	94
Rock Island	115	114	1	CEMVR_IL_LA_MVR_35	57
Rock Island	114	113	1	CEMVR_IL_LA_MVR_34	38
Rock Island	113	112	1	CEMVR_IL_LA_MVR_33	37
Rock Island	112	111	1	CEMVR_IL_LA_MVR_32	59
Rock Island	111	110	1	CEMVR_IL_LA_MVR_31	38
Rock Island	110	109	1	CEMVR_IL_LA_MVR_30	36
Rock Island	109	108	1	CEMVR_IL_LA_MVR_29	81
Rock Island	108	107	1	CEMVR_IL_LA_MVR_28	65
Rock Island	107	106	1	CEMVR_IL_LA_MVR_27	35
Rock Island	106	105	1	CEMVR_IL_LA_MVR_26	33
Rock Island	105	104	1	CEMVR_IL_LA_MVR_25	44

Table 6 (cont.). Illinois River reaches with low transit counts, 2021.

USACE District	Upstream End of Reach, Illinois River Mile	Downstream End of Reach, Illinois River Mile	Reach Length (mi)	Illinois River Reaches with Low AIS Coverage	2021 Total Observed Transits (Upbound and Downbound)
Rock Island	104	103	1	CEMVR_IL_LA_MVR_24	48
Rock Island	103	102	1	CEMVR_IL_LA_MVR_23	48
Rock Island	102	101	1	CEMVR_IL_LA_MVR_22	34
Rock Island	101	100	1	CEMVR_IL_LA_MVR_21	31
Rock Island	100	99	1	CEMVR_IL_LA_MVR_20	40
Rock Island	99	98	1	CEMVR_IL_LA_MVR_19	37
Rock Island	98	97	1	CEMVR_IL_LA_MVR_18	46
Rock Island	97	96	1	CEMVR_IL_LA_MVR_17	86
Rock Island	96	95	1	CEMVR_IL_LA_MVR_16	65
Rock Island	95	94	1	CEMVR_IL_LA_MVR_15	94
Rock Island	94	93	1	CEMVR_IL_LA_MVR_14	184
Rock Island	93	92	1	CEMVR_IL_LA_MVR_13	154
Rock Island	92	91	1	CEMVR_IL_LA_MVR_12	218
Rock Island	91	90	1	CEMVR_IL_LA_MVR_11	513
Rock Island	90	89	1	CEMVR_IL_LA_MVR_10	573
Rock Island	87	86	1	CEMVR_IL_LA_MVR_7	712
St. Louis	70.1	44.1	26	CEMVS_IL_SL_IL2_3	649

Figure 11. AIS coverage map, Illinois River, RMs 240–320.

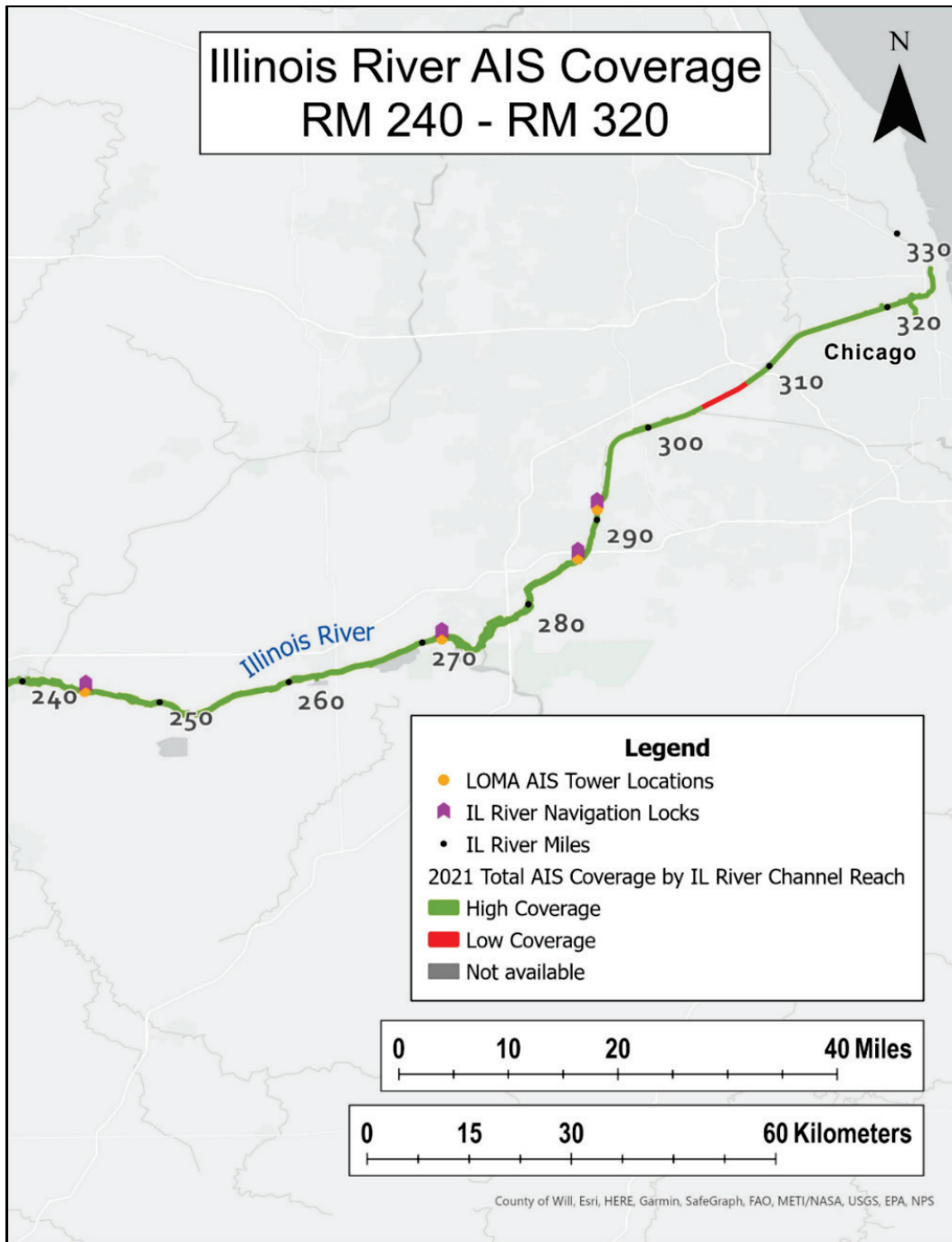


Figure 12. AIS coverage map, Illinois River, RMs 120–240.

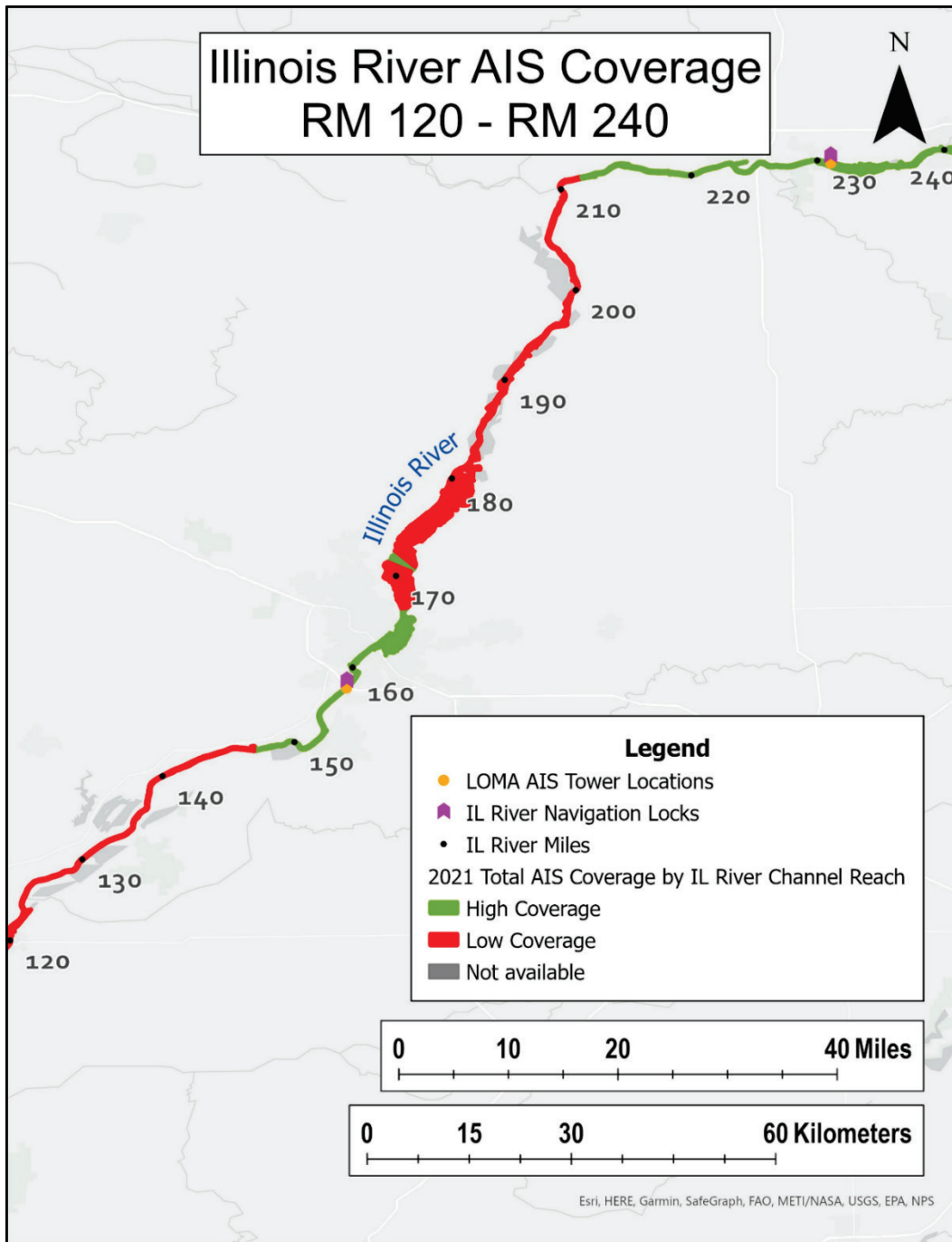
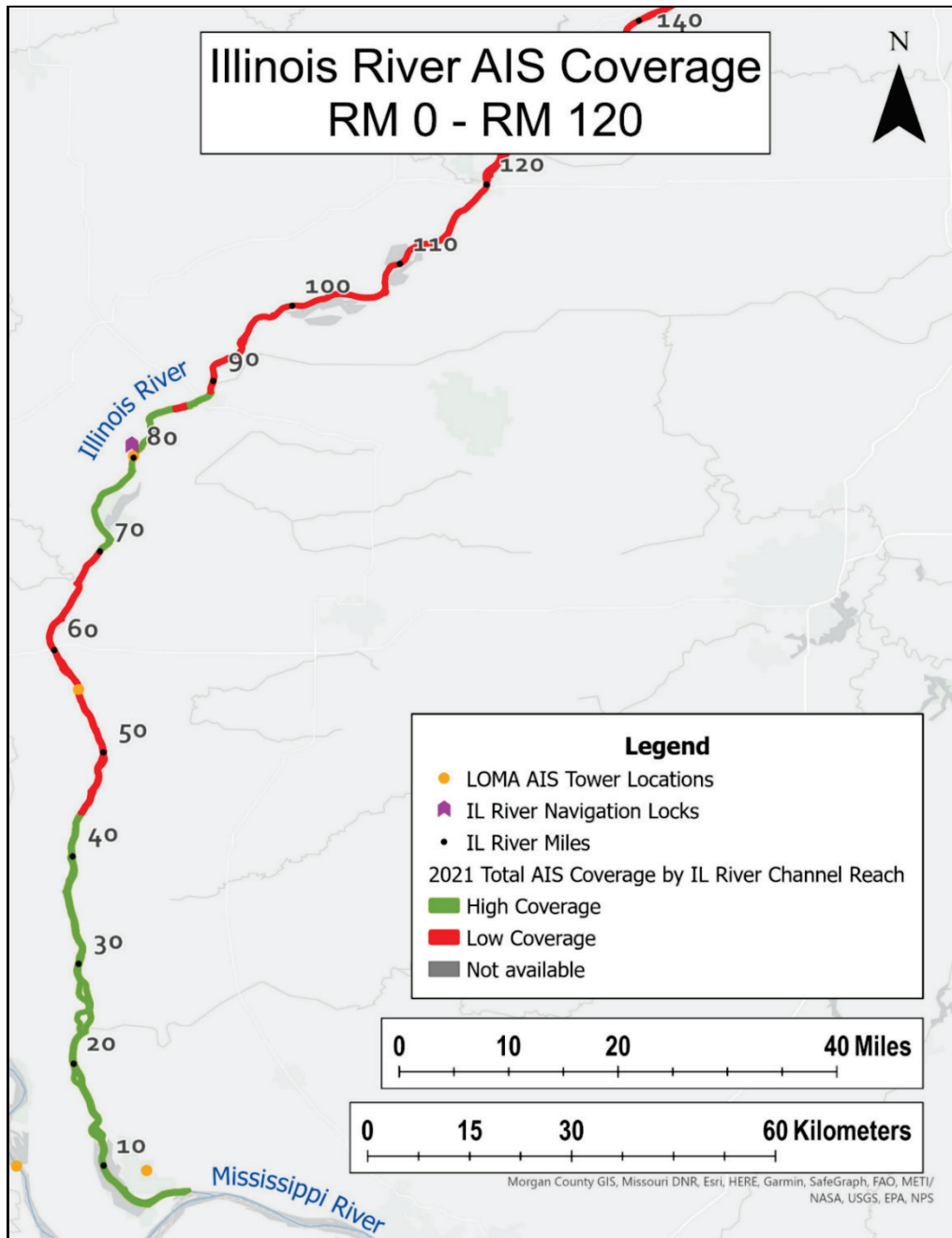


Figure 13. AIS coverage map, Illinois River, RMs 0-120.



4.2.5 Ohio River Summary

Of the 981 river miles of the Ohio River examined in this project, 644 mi (66%) had high coverage, and 337 mi (34%) had low coverage. Table 7 presents the extent of contiguous sections of high or low coverage along the Ohio River, based on the naming using the NCF with river miles included for reference.

Table 7. AIS coverage summary, Ohio River, 2021.

RM Start	RM End	RM Length	Ohio River Reach ID Start	Ohio River Reach ID End	2021 Coverage Qualitative Category
0	41	41	CELRP_OH_LP_EMS_1	CELRP_OH_LP_NC2_1	High
41	45	4	CELRP_OH_LP_NC2_2	CELRP_OH_LP_NC2_5	Low
45	63	18	CELRP_OH_LP_NC2_6	CELRP_OH_LP_PIK_9	High
63	70	7	CELRP_OH_LP_PIK_10	CELRP_OH_LP_PIK_16	Low
70	72	2	CELRP_OH_LP_PIK_17	CELRP_OH_LP_PIK_18	High
72	73	1	CELRP_OH_LP_PIK_19	CELRP_OH_LP_PIK_19	Low
73	98	25	CELRP_OH_LP_PIK_20	CELRP_OH_LP_HAN_14	High
98	117	19	CELRP_OH_LP_HAN_15	CELRP_OH_LP_HAN_33	Low
117	135	18	CELRP_OH_LP_HAN_34	CELRH_OH_HD_WIO_29	High
135	147	12	CELRH_OH_HD_WIO_28	CELRH_OH_HD_WIO_17	Low
147	172	25	CELRH_OH_HD_WIO_16	CELRH_OH_HD_BEL_34	High
172	178	6	CELRH_OH_HD_BEL_33	CELRH_OH_HD_BEL_28	Low
178	179	1	CELRH_OH_HD_BEL_27	CELRH_OH_HD_BEL_27	High
179	189	10	CELRH_OH_HD_BEL_26	CELRH_OH_HD_BEL_17	Low
189	248	59	CELRH_OH_HD_BEL_16	CELRH_OH_HD_RCB_33	High
248	255	7	CELRH_OH_HD_RCB_32	CELRH_OH_HD_RCB_26	Low
255	355	100	CELRH_OH_HD_RCB_25	CELRH_OH_HD_CAM_84	High
355	357	2	CELRH_OH_HD_CAM_83	CELRH_OH_HD_CAM_82	Low
357	358	1	CELRH_OH_HD_CAM_81	CELRH_OH_HD_CAM_81	High
358	372	14	CELRH_OH_HD_CAM_80	CELRH_OH_HD_CAM_67	Low
372	373	1	CELRH_OH_HD_CAM_66	CELRH_OH_HD_CAM_66	High
373	418	45	CELRH_OH_HD_CAM_65	CELRH_OH_HD_CAM_21	Low
418	421	3	CELRH_OH_HD_CAM_20	CELRH_OH_HD_CAM_18	High
421	423	2	CELRH_OH_HD_CAM_17	CELRH_OH_HD_CAM_16	Low
423	490	67	CELRH_OH_HD_CAM_15	CELRL_OH_LD_MKL_4	High
490	530	40	CELRL_OH_LD_MKL_3	CELRL_OH_LD_MKL_2	Low
530	544	14	CELRL_OH_LD_MKL_1	CELRL_OH_LD_MCA_6	High
544	584	40	CELRL_OH_LD_MCA_5	CELRL_OH_LD_MCA_3	Low
584	625	41	CELRL_OH_LD_MCA_2	CELRL_OH_LD_CAN_8	High
625	700	75	CELRL_OH_LD_CAN_7	CELRL_OH_LD_CAN_3	Low
700	727	27	CELRL_OH_LD_CAN_2	CELRL_OH_LD_NBG_12	High
727	754	27	CELRL_OH_LD_NBG_11	CELRL_OH_LD_NBG_5	Low
754	865	111	CELRL_OH_LD_NBG_4	CELRL_OH_LD_SMT_11	High
865	891	26	CELRL_OH_LD_SMT_10	CELRL_OH_LD_SMT_6	Low
891	981	90	CELRL_OH_LD_SMT_5	CELRL_OH_LD_CAI_1	High

4.2.6 Ohio River AIS Coverage Details

The Ohio River reaches included in this study started at RM 0 in Pittsburgh, Pennsylvania, and continued to RM 980 at the confluence with the Mississippi River near Cairo, Illinois.

Figure 14 presents a map of the high and low coverage areas from RM 0 to RM 980. Figure 15 presents a more detailed view of high and low coverage for RM 0 to 150; Figure 16 covers RM 150 to 360; Figure 17 spans RM 360 to 540; Figure 18 covers RM 540 to 760; and Figure 19 covers RM 760 to RM 980 at the confluence with the Mississippi River. Table 8 presents the list of Ohio River reaches with low observed transit counts based on data from 2021.

Figure 14. AIS coverage map, Ohio River, RMs 0–980.

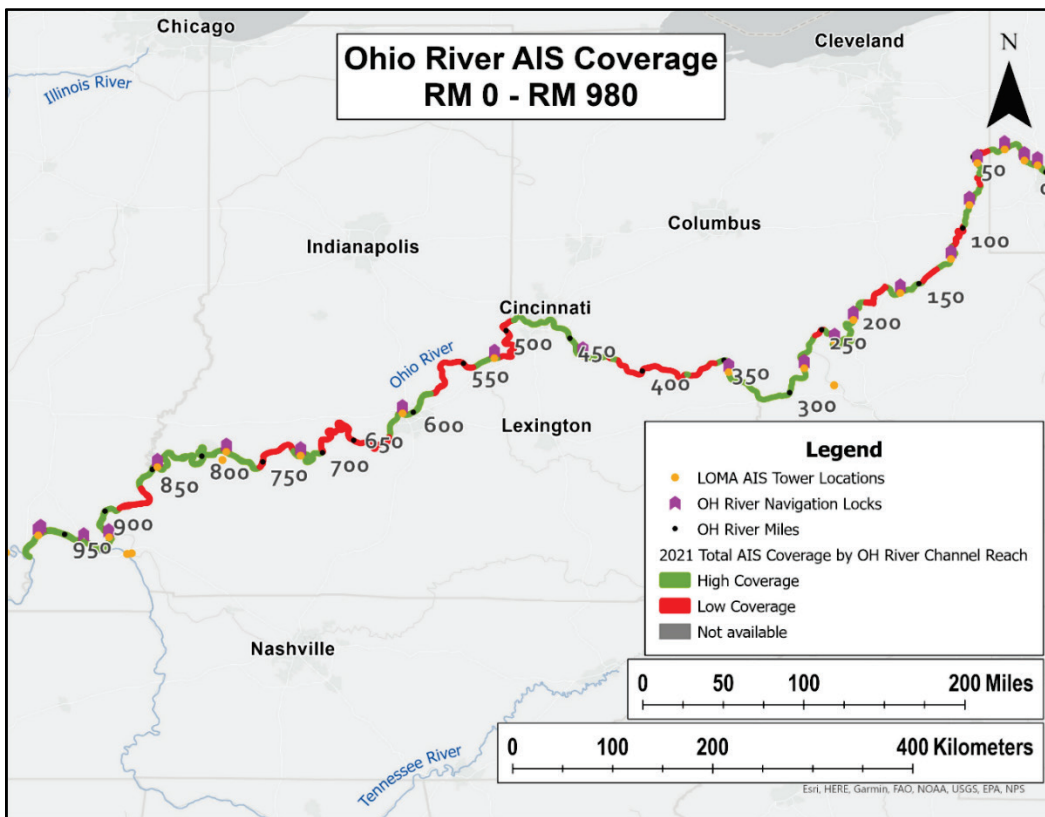


Table 8. Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Pittsburgh	CELRP_OH_LP_NC2_2	41	42	166
Pittsburgh	CELRP_OH_LP_NC2_3	42	43	24
Pittsburgh	CELRP_OH_LP_NC2_4	43	44	103
Pittsburgh	CELRP_OH_LP_NC2_5	44	45	534
Pittsburgh	CELRP_OH_LP_PIK_10	63	64	692
Pittsburgh	CELRP_OH_LP_PIK_11	64	65	3
Pittsburgh	CELRP_OH_LP_PIK_12	65	66	0
Pittsburgh	CELRP_OH_LP_PIK_13	66	67	0
Pittsburgh	CELRP_OH_LP_PIK_14	67	68	4
Pittsburgh	CELRP_OH_LP_PIK_15	68	69	18
Pittsburgh	CELRP_OH_LP_PIK_16	69	70	67
Pittsburgh	CELRP_OH_LP_PIK_19	72	73	730
Pittsburgh	CELRP_OH_LP_HAN_15	98	99	532
Pittsburgh	CELRP_OH_LP_HAN_16	99	100	479
Pittsburgh	CELRP_OH_LP_HAN_17	100	101	537
Pittsburgh	CELRP_OH_LP_HAN_18	101	102	198
Pittsburgh	CELRP_OH_LP_HAN_19	102	103	1
Pittsburgh	CELRP_OH_LP_HAN_20	103	104	0
Pittsburgh	CELRP_OH_LP_HAN_21	104	105	0
Pittsburgh	CELRP_OH_LP_HAN_22	105	106	0
Pittsburgh	CELRP_OH_LP_HAN_23	106	107	0
Pittsburgh	CELRP_OH_LP_HAN_24	107	108	0
Pittsburgh	CELRP_OH_LP_HAN_25	108	109	0
Pittsburgh	CELRP_OH_LP_HAN_26	109	110	0
Pittsburgh	CELRP_OH_LP_HAN_27	110	111	6
Pittsburgh	CELRP_OH_LP_HAN_28	111	112	2
Pittsburgh	CELRP_OH_LP_HAN_29	112	113	1
Pittsburgh	CELRP_OH_LP_HAN_30	113	114	0
Pittsburgh	CELRP_OH_LP_HAN_31	114	115	0
Pittsburgh	CELRP_OH_LP_HAN_32	115	116	0
Pittsburgh	CELRP_OH_LP_HAN_33	116	117	10
Huntington	CELRH_OH_HD_WIO_28	135	136	532
Huntington	CELRH_OH_HD_WIO_27	136	137	630
Huntington	CELRH_OH_HD_WIO_26	137	138	332
Huntington	CELRH_OH_HD_WIO_25	138	139	194

Table 8 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Huntington	CELRH_OH_HD_WIO_24	139	140	88
Huntington	CELRH_OH_HD_WIO_23	140	141	76
Huntington	CELRH_OH_HD_WIO_22	141	142	18
Huntington	CELRH_OH_HD_WIO_21	142	143	3
Huntington	CELRH_OH_HD_WIO_20	143	144	1
Huntington	CELRH_OH_HD_WIO_19	144	145	1
Huntington	CELRH_OH_HD_WIO_18	145	146	2
Huntington	CELRH_OH_HD_WIO_17	146	147	183
Huntington	CELRH_OH_HD_BEL_33	172	173	197
Huntington	CELRH_OH_HD_BEL_32	173	174	208
Huntington	CELRH_OH_HD_BEL_31	174	175	106
Huntington	CELRH_OH_HD_BEL_30	175	176	38
Huntington	CELRH_OH_HD_BEL_29	176	177	35
Huntington	CELRH_OH_HD_BEL_28	177	178	250
Huntington	CELRH_OH_HD_BEL_26	179	180	423
Huntington	CELRH_OH_HD_BEL_25	180	181	442
Huntington	CELRH_OH_HD_BEL_24	181	182	184
Huntington	CELRH_OH_HD_BEL_23	182	183	174
Huntington	CELRH_OH_HD_BEL_22	183	184	410
Huntington	CELRH_OH_HD_BEL_21	184	185	163
Huntington	CELRH_OH_HD_BEL_20	185	186	167
Huntington	CELRH_OH_HD_BEL_19	186	187	273
Huntington	CELRH_OH_HD_BEL_18	187	188	315
Huntington	CELRH_OH_HD_BEL_17	188	189	530
Huntington	CELRH_OH_HD_RCB_32	248	249	413
Huntington	CELRH_OH_HD_RCB_31	249	250	103
Huntington	CELRH_OH_HD_RCB_30	250	251	121
Huntington	CELRH_OH_HD_RCB_29	251	252	153
Huntington	CELRH_OH_HD_RCB_28	252	253	105
Huntington	CELRH_OH_HD_RCB_27	253	254	66
Huntington	CELRH_OH_HD_RCB_26	254	255	90
Huntington	CELRH_OH_HD_CAM_83	355	356	293
Huntington	CELRH_OH_HD_CAM_82	356	357	434
Huntington	CELRH_OH_HD_CAM_80	358	359	479
Huntington	CELRH_OH_HD_CAM_79	359	360	93

Table 8 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Huntington	CELRH_OH_HD_CAM_78	360	361	70
Huntington	CELRH_OH_HD_CAM_77	361	362	76
Huntington	CELRH_OH_HD_CAM_76	362	363	332
Huntington	CELRH_OH_HD_CAM_75	363	364	258
Huntington	CELRH_OH_HD_CAM_74	364	365	272
Huntington	CELRH_OH_HD_CAM_72	365	367	33
Huntington	CELRH_OH_HD_CAM_73	365	366	63
Huntington	CELRH_OH_HD_CAM_71	367	368	46
Huntington	CELRH_OH_HD_CAM_70	368	369	60
Huntington	CELRH_OH_HD_CAM_69	369	370	383
Huntington	CELRH_OH_HD_CAM_68	370	371	443
Huntington	CELRH_OH_HD_CAM_67	371	372	721
Huntington	CELRH_OH_HD_CAM_65	373	374	79
Huntington	CELRH_OH_HD_CAM_64	374	375	48
Huntington	CELRH_OH_HD_CAM_63	375	376	22
Huntington	CELRH_OH_HD_CAM_62	376	377	13
Huntington	CELRH_OH_HD_CAM_61	377	378	21
Huntington	CELRH_OH_HD_CAM_60	378	379	18
Huntington	CELRH_OH_HD_CAM_59	379	380	34
Huntington	CELRH_OH_HD_CAM_58	380	381	49
Huntington	CELRH_OH_HD_CAM_57	381	382	23
Huntington	CELRH_OH_HD_CAM_56	382	383	21
Huntington	CELRH_OH_HD_CAM_55	383	384	30
Huntington	CELRH_OH_HD_CAM_54	384	385	93
Huntington	CELRH_OH_HD_CAM_53	385	386	158
Huntington	CELRH_OH_HD_CAM_52	386	387	106
Huntington	CELRH_OH_HD_CAM_51	387	388	79
Huntington	CELRH_OH_HD_CAM_50	388	389	107
Huntington	CELRH_OH_HD_CAM_49	389	390	52
Huntington	CELRH_OH_HD_CAM_48	390	391	41
Huntington	CELRH_OH_HD_CAM_47	391	392	116
Huntington	CELRH_OH_HD_CAM_46	392	393	58
Huntington	CELRH_OH_HD_CAM_45	393	394	25
Huntington	CELRH_OH_HD_CAM_44	394	395	10
Huntington	CELRH_OH_HD_CAM_43	395	396	3

Table 8 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Huntington	CELRH_OH_HD_CAM_42	396	397	2
Huntington	CELRH_OH_HD_CAM_41	397	398	2
Huntington	CELRH_OH_HD_CAM_40	398	399	3
Huntington	CELRH_OH_HD_CAM_39	399	400	3
Huntington	CELRH_OH_HD_CAM_38	400	401	1
Huntington	CELRH_OH_HD_CAM_37	401	402	0
Huntington	CELRH_OH_HD_CAM_36	402	403	15
Huntington	CELRH_OH_HD_CAM_35	403	404	217
Huntington	CELRH_OH_HD_CAM_34	404	405	252
Huntington	CELRH_OH_HD_CAM_33	405	406	37
Huntington	CELRH_OH_HD_CAM_32	406	407	16
Huntington	CELRH_OH_HD_CAM_31	407	408	14
Huntington	CELRH_OH_HD_CAM_30	408	409	18
Huntington	CELRH_OH_HD_CAM_29	409	410	4
Huntington	CELRH_OH_HD_CAM_28	410	411	3
Huntington	CELRH_OH_HD_CAM_27	411	412	14
Huntington	CELRH_OH_HD_CAM_26	412	413	216
Huntington	CELRH_OH_HD_CAM_25	413	414	296
Huntington	CELRH_OH_HD_CAM_24	414	415	24
Huntington	CELRH_OH_HD_CAM_23	415	416	8
Huntington	CELRH_OH_HD_CAM_22	416	417	8
Huntington	CELRH_OH_HD_CAM_21	417	418	140
Huntington	CELRH_OH_HD_CAM_17	421	422	718
Huntington	CELRH_OH_HD_CAM_16	422	423	650
Louisville	CELRL_OH_LD_MKL_3	490	510	275
Louisville	CELRL_OH_LD_MKL_2	510	530	386
Louisville	CELRL_OH_LD_MCA_5	544	556	21
Louisville	CELRL_OH_LD_MCA_4	556	565	3
Louisville	CELRL_OH_LD_MCA_3	565	584	12
Louisville	CELRL_OH_LD_CAN_7	625	639	260
Louisville	CELRL_OH_LD_CAN_6	639	659	1
Louisville	CELRL_OH_LD_CAN_5	659	664	0
Louisville	CELRL_OH_LD_CAN_4	664	680	0
Louisville	CELRL_OH_LD_CAN_3	680	700	7
Louisville	CELRL_OH_LD_NBG_11	727	731	46

Table 8 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Louisville	CELRL_OH_LD_NBG_10	731	733	4
Louisville	CELRL_OH_LD_NBG_9	733	738.5	7
Louisville	CELRL_OH_LD_NBG_8	738.5	741.2	63
Louisville	CELRL_OH_LD_NBG_7	741.2	745	80
Louisville	CELRL_OH_LD_NBG_6	745	749	105
Louisville	CELRL_OH_LD_NBG_5	749	754	381
Louisville	CELRL_OH_LD_SMT_10	865	868.6	3
Louisville	CELRL_OH_LD_SMT_9	868.6	872.8	1
Louisville	CELRL_OH_LD_SMT_8	872.8	877.1	2
Louisville	CELRL_OH_LD_SMT_7	877.1	884	3
Louisville	CELRL_OH_LD_SMT_6	884	891	661

Figure 15. AIS coverage map, Ohio River, RMs 0–150.

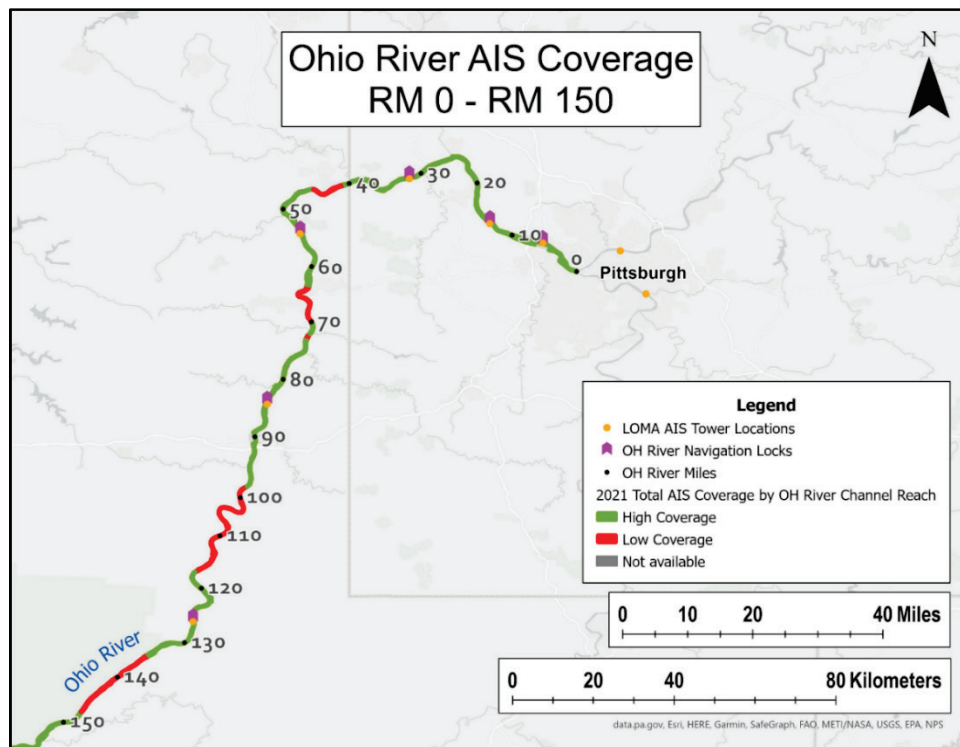


Figure 16. AIS coverage map, Ohio River, RMs 150–360.

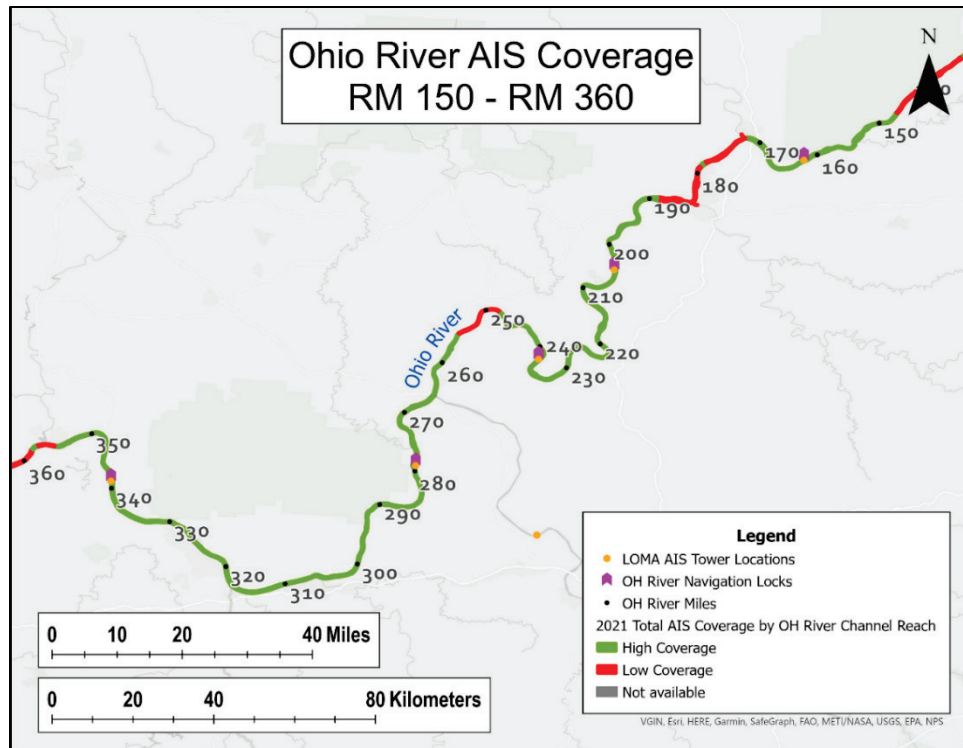


Figure 17. AIS coverage map, Ohio River, RMs 360–540.

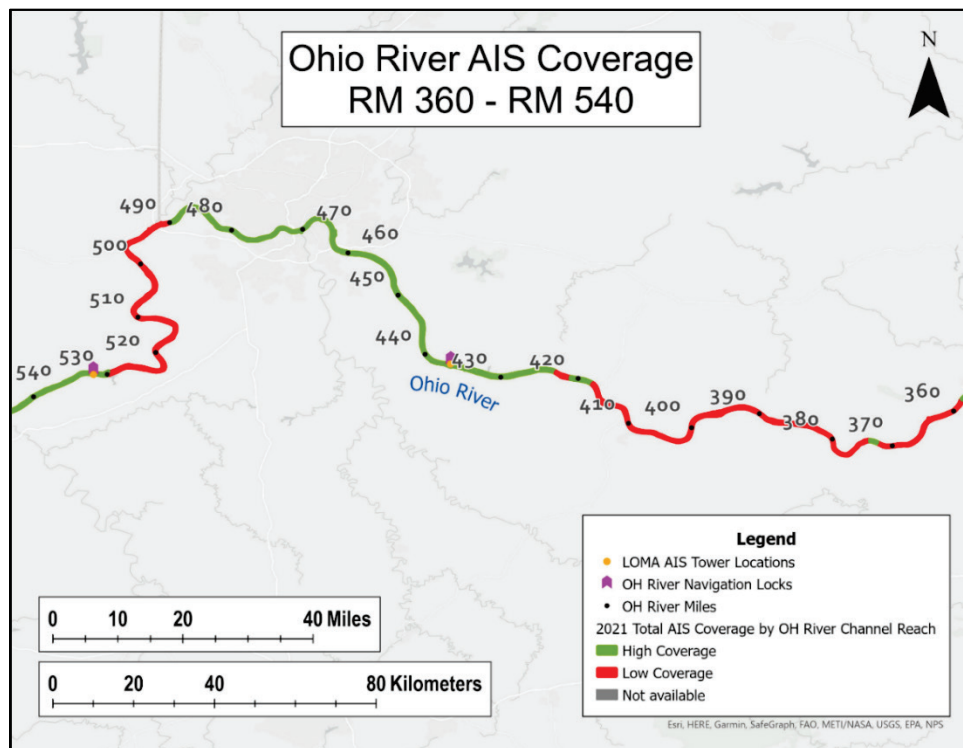


Figure 18. AIS coverage map, Ohio River, RMs 540–760.

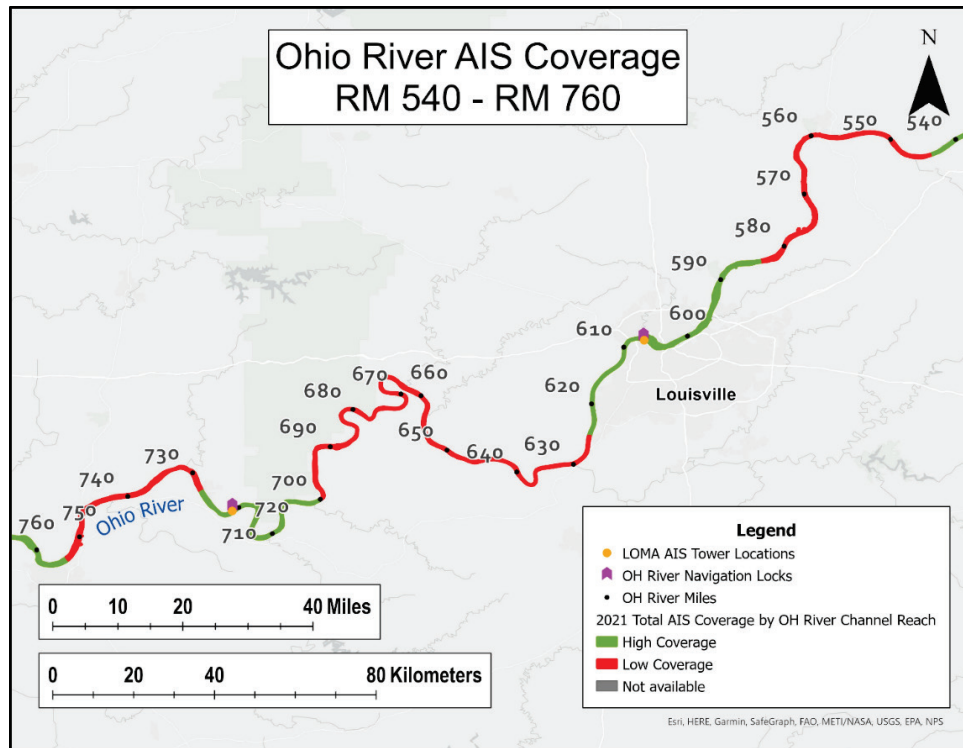
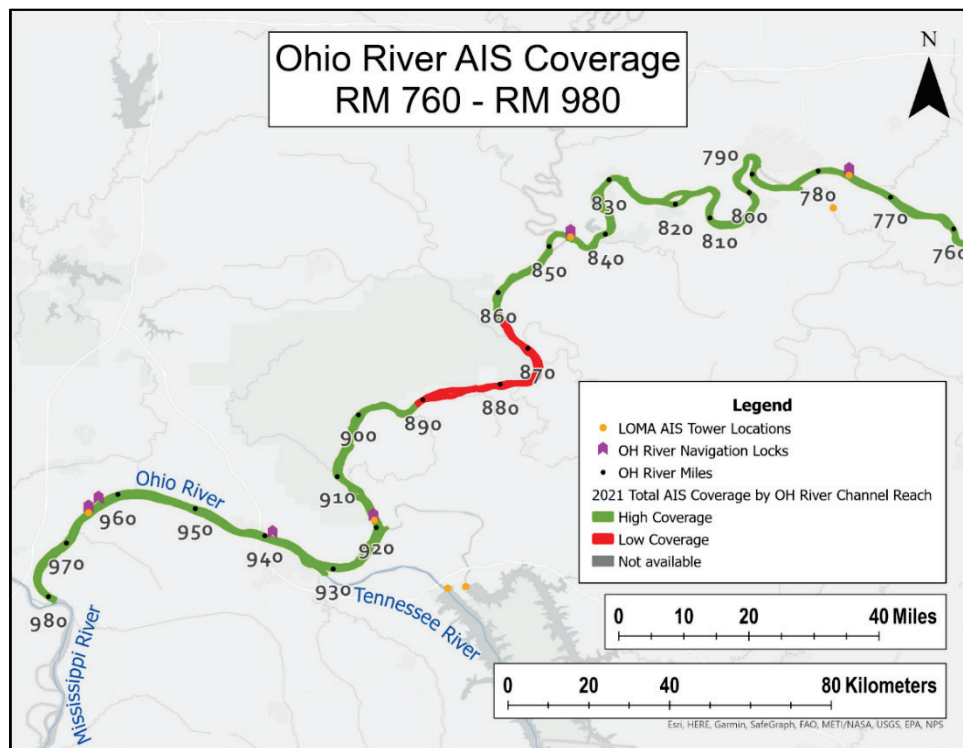


Figure 19. AIS coverage map, Ohio River, RMs 760–980.



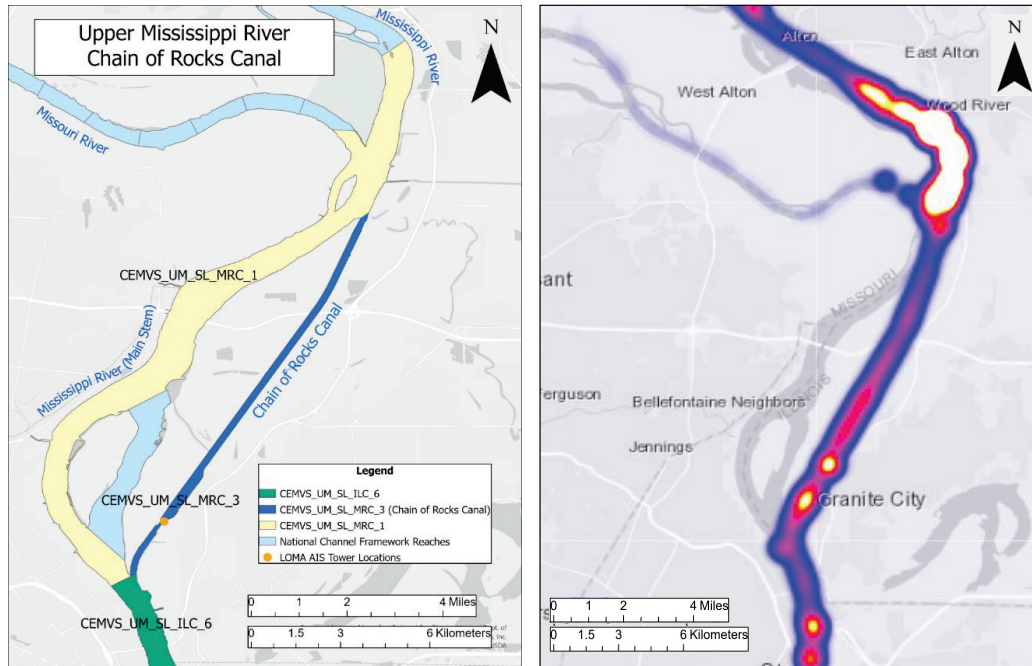
4.3 Manual Assignment to High-Coverage Category

There were a small number of UMR reaches that had no transits recorded in the AIS data record in 2021 due to geospatial processing problems. Upon examination of available AIS data inside the reach boundaries, they were manually assigned to the high-coverage category. The reaches were CEMVR_UM_13_MVR_29 (RM 528 to 527), CEMVR_UM_22_MVR_24 (RM 302 to 301.2), CEMVS_UM_SL_P24_2 (RM 301.1 to 286), and CEMVS_UM_SL_MRC_1 (RM 184 to 198). The reasons for manual assignment to the high-coverage category are described below.

4.3.1 CEMVS_UM_SL_MRC_1 (RM 184–198)

In the area upriver from St. Louis, Missouri, vessels transit through the Chain of Rocks Canal east of the main stem of the Mississippi River. As shown in the AIS signal density map (heatmap) in Figure 20 (*right panel*), the upstream end of reach CEMVS_UM_SL_MRC_1 receives commercial traffic, but that traffic transits the Chain of Rocks Canal (reach CEMVS_UM_SL_MRC_3) and enters or exits at the upstream end of reach CEMVS_UM_SL_ILC_6. This bypasses the geofence at the downstream end of CEMVS_UM_SL_MRC_1, and thus in the automated transit calculation process used for this study, no transits were recorded. It was manually categorized as high coverage. The AIS signal density maps (heatmaps) in this report were generated using the AIS Analysis Package software (USACE-ERDC 2018).

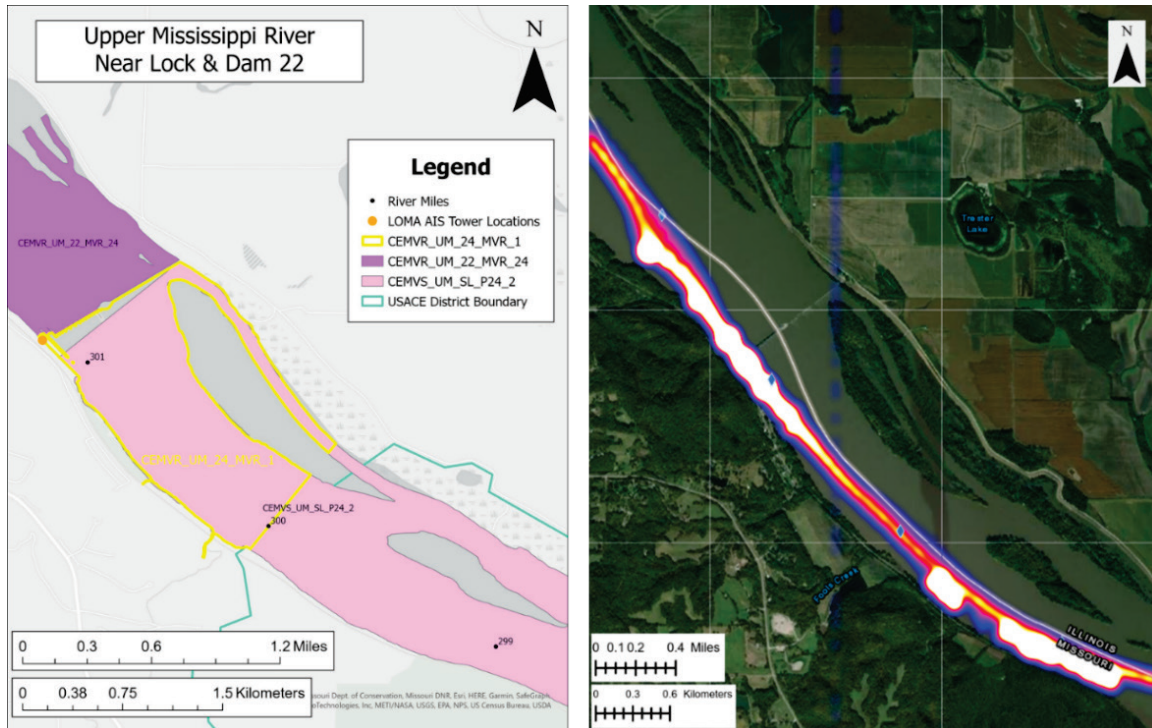
Figure 20. *Left panel:* NCF reach boundaries around the Chain of Rocks Canal (dark blue) on the UMR. *Right panel:* AIS signal-density map, October 2020, showing vessel traffic using the upstream end of reach CEMVS_UM_SL_MRC_1, the Chain of Rocks Canal, and CEMVS_UM_SL_ILC_6.



4.3.2 CEMVR_UM_22_MVR_24, CEMVR_UM_24_MVR_1 and CEMVS_UM_SL_P24_2 (RM 286-302)

In the area downriver from Lock & Dam 22 near New London, Missouri, there are overlapping NCF reaches from two different USACE districts. This causes an error in the geoprocessing logic whereby a vessel would have to jump backwards while moving forward in time to pass through geofences at the end of each reach in the correct sequence. Figure 21, *left panel*, shows the reach CEMVR_UM_22_MVR_24 in purple and upstream of the dam, the yellow outline marks the boundary of CEMVR_UM_24_MVR_1 downstream from the lock and dam structure to RM 300. This overlaps with the downstream reach CEMVS_UM_SL_P24_2 (light pink) which reaches upstream past RM 300 to the lower edge of the dam (Figure 21). While this geospatial overlap may facilitate certain types of hydrographic survey recordkeeping, in this instance, it causes an error by assigning spatial boundaries that overlap rather than abut. AIS coverage in this area is strong as shown by the *right panel* in Figure 21, which displays an AIS signal density map (heatmap) of vessel traffic from October 2020. As a result of this, both CEMVR_UM_24_MVR_1 and CEMVS_UM_SL_P24_2 were manually assigned to the high-coverage category.

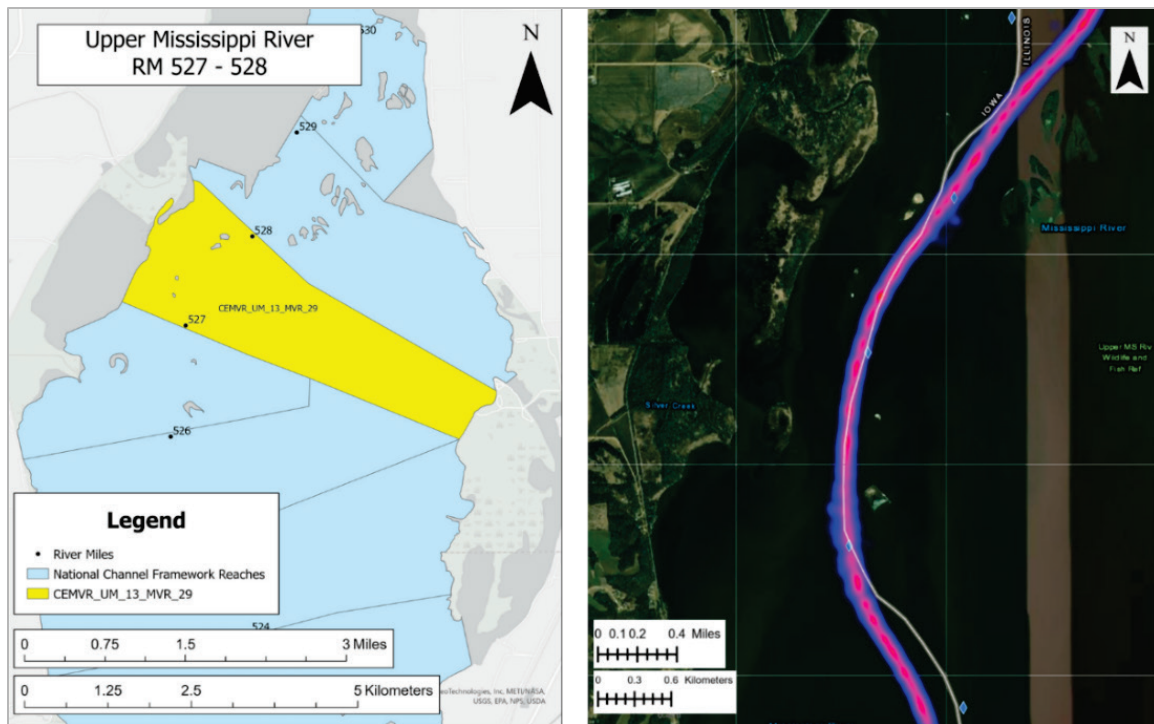
Figure 21. *Left panel:* NCF reaches with overlapping boundaries near Lock & Dam 22 at RM 301, UMR. *Right panel:* AIS signal-density map, October 2020, showing vessel traffic using the same area; *blue diamonds* mark river miles.



4.3.3 CEMVR_UM_13_MVR_29 (RM 527–528)

For the area between RM 527 to 528, the automated geoprocessing method recorded zero transits. However, the AIS reception in this area is high, as shown in the AIS signal-density map in the *right panel* of Figure 22. The cause for the geoprocessing error is under investigation, but for this project, the reach CEMVR_UM_13_MVR_29 has been manually assigned to the high-coverage group.

Figure 22. *Left panel:* NCF reaches from RM 526 to 529, UMR. Reach CEMVR_UM_13_MVR_29 is highlighted in *yellow*. *Right panel:* AIS signal-density map, October 2020, showing vessel traffic using the same area with no break in signal density.



Summary there were nine reaches originally categorized as “low coverage” in 2021, after manual correction this number was reduced to six reaches which equal 2% of the UMR included in the study. The reaches with low transit counts in 2021 are listed in Table 9, including those that were manually assigned to the high coverage category. The appendix provides calculated transit counts.

Table 9. Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Pittsburgh	CELRP_OH_LP_NC2_2	41	42	166
Pittsburgh	CELRP_OH_LP_NC2_3	42	43	24
Pittsburgh	CELRP_OH_LP_NC2_4	43	44	103
Pittsburgh	CELRP_OH_LP_NC2_5	44	45	534
Pittsburgh	CELRP_OH_LP_PIK_10	63	64	692
Pittsburgh	CELRP_OH_LP_PIK_11	64	65	3
Pittsburgh	CELRP_OH_LP_PIK_12	65	66	0
Pittsburgh	CELRP_OH_LP_PIK_13	66	67	0
Pittsburgh	CELRP_OH_LP_PIK_14	67	68	4
Pittsburgh	CELRP_OH_LP_PIK_15	68	69	18
Pittsburgh	CELRP_OH_LP_PIK_16	69	70	67
Pittsburgh	CELRP_OH_LP_PIK_19	72	73	730
Pittsburgh	CELRP_OH_LP_HAN_15	98	99	532
Pittsburgh	CELRP_OH_LP_HAN_16	99	100	479
Pittsburgh	CELRP_OH_LP_HAN_17	100	101	537
Pittsburgh	CELRP_OH_LP_HAN_18	101	102	198
Pittsburgh	CELRP_OH_LP_HAN_19	102	103	1
Pittsburgh	CELRP_OH_LP_HAN_20	103	104	0
Pittsburgh	CELRP_OH_LP_HAN_21	104	105	0
Pittsburgh	CELRP_OH_LP_HAN_22	105	106	0
Pittsburgh	CELRP_OH_LP_HAN_23	106	107	0
Pittsburgh	CELRP_OH_LP_HAN_24	107	108	0
Pittsburgh	CELRP_OH_LP_HAN_25	108	109	0
Pittsburgh	CELRP_OH_LP_HAN_26	109	110	0
Pittsburgh	CELRP_OH_LP_HAN_27	110	111	6
Pittsburgh	CELRP_OH_LP_HAN_28	111	112	2
Pittsburgh	CELRP_OH_LP_HAN_29	112	113	1
Pittsburgh	CELRP_OH_LP_HAN_30	113	114	0
Pittsburgh	CELRP_OH_LP_HAN_31	114	115	0
Pittsburgh	CELRP_OH_LP_HAN_32	115	116	0
Pittsburgh	CELRP_OH_LP_HAN_33	116	117	10
Huntington	CELRH_OH_HD_WIO_28	135	136	532
Huntington	CELRH_OH_HD_WIO_27	136	137	630
Huntington	CELRH_OH_HD_WIO_26	137	138	332
Huntington	CELRH_OH_HD_WIO_25	138	139	194

Table 9 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Huntington	CELRH_OH_HD_WIO_24	139	140	88
Huntington	CELRH_OH_HD_WIO_23	140	141	76
Huntington	CELRH_OH_HD_WIO_22	141	142	18
Huntington	CELRH_OH_HD_WIO_21	142	143	3
Huntington	CELRH_OH_HD_WIO_20	143	144	1
Huntington	CELRH_OH_HD_WIO_19	144	145	1
Huntington	CELRH_OH_HD_WIO_18	145	146	2
Huntington	CELRH_OH_HD_WIO_17	146	147	183
Huntington	CELRH_OH_HD_BEL_33	172	173	197
Huntington	CELRH_OH_HD_BEL_32	173	174	208
Huntington	CELRH_OH_HD_BEL_31	174	175	106
Huntington	CELRH_OH_HD_BEL_30	175	176	38
Huntington	CELRH_OH_HD_BEL_29	176	177	35
Huntington	CELRH_OH_HD_BEL_28	177	178	250
Huntington	CELRH_OH_HD_BEL_26	179	180	423
Huntington	CELRH_OH_HD_BEL_25	180	181	442
Huntington	CELRH_OH_HD_BEL_24	181	182	184
Huntington	CELRH_OH_HD_BEL_23	182	183	174
Huntington	CELRH_OH_HD_BEL_22	183	184	410
Huntington	CELRH_OH_HD_BEL_21	184	185	163
Huntington	CELRH_OH_HD_BEL_20	185	186	167
Huntington	CELRH_OH_HD_BEL_19	186	187	273
Huntington	CELRH_OH_HD_BEL_18	187	188	315
Huntington	CELRH_OH_HD_BEL_17	188	189	530
Huntington	CELRH_OH_HD_RCB_32	248	249	413
Huntington	CELRH_OH_HD_RCB_31	249	250	103
Huntington	CELRH_OH_HD_RCB_30	250	251	121
Huntington	CELRH_OH_HD_RCB_29	251	252	153
Huntington	CELRH_OH_HD_RCB_28	252	253	105
Huntington	CELRH_OH_HD_RCB_27	253	254	66
Huntington	CELRH_OH_HD_RCB_26	254	255	90
Huntington	CELRH_OH_HD_CAM_83	355	356	293
Huntington	CELRH_OH_HD_CAM_82	356	357	434
Huntington	CELRH_OH_HD_CAM_80	358	359	479
Huntington	CELRH_OH_HD_CAM_79	359	360	93

Table 9 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Huntington	CELRH_OH_HD_CAM_78	360	361	70
Huntington	CELRH_OH_HD_CAM_77	361	362	76
Huntington	CELRH_OH_HD_CAM_76	362	363	332
Huntington	CELRH_OH_HD_CAM_75	363	364	258
Huntington	CELRH_OH_HD_CAM_74	364	365	272
Huntington	CELRH_OH_HD_CAM_72	365	367	33
Huntington	CELRH_OH_HD_CAM_73	365	366	63
Huntington	CELRH_OH_HD_CAM_71	367	368	46
Huntington	CELRH_OH_HD_CAM_70	368	369	60
Huntington	CELRH_OH_HD_CAM_69	369	370	383
Huntington	CELRH_OH_HD_CAM_68	370	371	443
Huntington	CELRH_OH_HD_CAM_67	371	372	721
Huntington	CELRH_OH_HD_CAM_65	373	374	79
Huntington	CELRH_OH_HD_CAM_64	374	375	48
Huntington	CELRH_OH_HD_CAM_63	375	376	22
Huntington	CELRH_OH_HD_CAM_62	376	377	13
Huntington	CELRH_OH_HD_CAM_61	377	378	21
Huntington	CELRH_OH_HD_CAM_60	378	379	18
Huntington	CELRH_OH_HD_CAM_59	379	380	34
Huntington	CELRH_OH_HD_CAM_58	380	381	49
Huntington	CELRH_OH_HD_CAM_57	381	382	23
Huntington	CELRH_OH_HD_CAM_56	382	383	21
Huntington	CELRH_OH_HD_CAM_55	383	384	30
Huntington	CELRH_OH_HD_CAM_54	384	385	93
Huntington	CELRH_OH_HD_CAM_53	385	386	158
Huntington	CELRH_OH_HD_CAM_52	386	387	106
Huntington	CELRH_OH_HD_CAM_51	387	388	79
Huntington	CELRH_OH_HD_CAM_50	388	389	107
Huntington	CELRH_OH_HD_CAM_49	389	390	52
Huntington	CELRH_OH_HD_CAM_48	390	391	41
Huntington	CELRH_OH_HD_CAM_47	391	392	116
Huntington	CELRH_OH_HD_CAM_46	392	393	58
Huntington	CELRH_OH_HD_CAM_45	393	394	25
Huntington	CELRH_OH_HD_CAM_44	394	395	10
Huntington	CELRH_OH_HD_CAM_43	395	396	3

Table 9 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Huntington	CELRH_OH_HD_CAM_42	396	397	2
Huntington	CELRH_OH_HD_CAM_41	397	398	2
Huntington	CELRH_OH_HD_CAM_40	398	399	3
Huntington	CELRH_OH_HD_CAM_39	399	400	3
Huntington	CELRH_OH_HD_CAM_38	400	401	1
Huntington	CELRH_OH_HD_CAM_37	401	402	0
Huntington	CELRH_OH_HD_CAM_36	402	403	15
Huntington	CELRH_OH_HD_CAM_35	403	404	217
Huntington	CELRH_OH_HD_CAM_34	404	405	252
Huntington	CELRH_OH_HD_CAM_33	405	406	37
Huntington	CELRH_OH_HD_CAM_32	406	407	16
Huntington	CELRH_OH_HD_CAM_31	407	408	14
Huntington	CELRH_OH_HD_CAM_30	408	409	18
Huntington	CELRH_OH_HD_CAM_29	409	410	4
Huntington	CELRH_OH_HD_CAM_28	410	411	3
Huntington	CELRH_OH_HD_CAM_27	411	412	14
Huntington	CELRH_OH_HD_CAM_26	412	413	216
Huntington	CELRH_OH_HD_CAM_25	413	414	296
Huntington	CELRH_OH_HD_CAM_24	414	415	24
Huntington	CELRH_OH_HD_CAM_23	415	416	8
Huntington	CELRH_OH_HD_CAM_22	416	417	8
Huntington	CELRH_OH_HD_CAM_21	417	418	140
Huntington	CELRH_OH_HD_CAM_17	421	422	718
Huntington	CELRH_OH_HD_CAM_16	422	423	650
Louisville	CELRL_OH_LD_MKL_3	490	510	275
Louisville	CELRL_OH_LD_MKL_2	510	530	386
Louisville	CELRL_OH_LD_MCA_5	544	556	21
Louisville	CELRL_OH_LD_MCA_4	556	565	3
Louisville	CELRL_OH_LD_MCA_3	565	584	12
Louisville	CELRL_OH_LD_CAN_7	625	639	260
Louisville	CELRL_OH_LD_CAN_6	639	659	1
Louisville	CELRL_OH_LD_CAN_5	659	664	0
Louisville	CELRL_OH_LD_CAN_4	664	680	0
Louisville	CELRL_OH_LD_CAN_3	680	700	7
Louisville	CELRL_OH_LD_NBG_11	727	731	46

Table 9 (cont.). Ohio River reaches with low transit counts, 2021.

USACE District	Ohio River Reaches with Low AIS Coverage	Upstream End of Reach, Ohio River Mile	Downstream End of Reach, Ohio River Mile	2021 Total Observed Transits (Upbound and Downbound)
Louisville	CELRL_OH_LD_NBG_10	731	733	4
Louisville	CELRL_OH_LD_NBG_9	733	738.5	7
Louisville	CELRL_OH_LD_NBG_8	738.5	741.2	63
Louisville	CELRL_OH_LD_NBG_7	741.2	745	80
Louisville	CELRL_OH_LD_NBG_6	745	749	105
Louisville	CELRL_OH_LD_NBG_5	749	754	381
Louisville	CELRL_OH_LD_SMT_10	865	868.6	3
Louisville	CELRL_OH_LD_SMT_9	868.6	872.8	1
Louisville	CELRL_OH_LD_SMT_8	872.8	877.1	2
Louisville	CELRL_OH_LD_SMT_7	877.1	884	3
Louisville	CELRL_OH_LD_SMT_6	884	891	661

4.4 Summary by US Army Corps of Engineers (USACE) District

This section presents a summary of the AIS coverage results organized by USACE district boundaries. The waterways examined in this project span the following USACE districts: Pittsburgh, Huntington, Louisville, New Orleans, Vicksburg, Memphis, St. Paul, Rock Island, and St. Louis. Some districts have responsibility for more than one waterway. In the waterways included in this study, both St. Louis and Rock Island Districts are responsible for maintaining different sections of the UMR and the Illinois River. Districts may also have responsibility for tributary waterways not included in this project but which may be included in future AIS coverage examinations.

Table 10 presents an AIS coverage summary organized by district and by the four waterways included in this study. Of the 2,888.5 river miles considered across the four waterways, a total of 2,345.1 river miles (81%) were assigned to the high-coverage category (including manually assigned reaches) while only 534.3 river miles (19%) were assigned to the low-coverage category. Table 11 presents the district-level summaries of high- and low-coverage percentages and total river miles in each category, not specified by waterway.

Table 10. AIS coverage summary by district and waterway, 2021.

District	District Abbreviation	High-Coverage River Miles	Low-Coverage River Miles	Total River Miles	Waterway
St. Louis	CEMVS	57	26	83	Illinois
Rock Island	CEMVR	133.5	107	240.5	Illinois
Pittsburgh	CELRP	96	31	127	Ohio
Huntington	CELRH	213	99	312	Ohio
Louisville	CELRL	335	208	543	Ohio
St. Paul	CEMVP	218.65	14.4	233.05	UMR
Rock Island	CEMVR	307.8	3	310.8	UMR
St. Louis	CEMVS	311.1	0	311.1	UMR and part of LMR

Table 11. AIS coverage summary by district, select waterways, 2021.

District	District Abbreviation	High-Coverage River Miles	Low-Coverage River Miles	Total River Miles	% High Coverage	% Low Coverage
Pittsburgh	CELRP	96	31	127	76%	24%
Huntington	CELRH	213	99	312	68%	32%
Louisville	CELRL	335	208	543	62%	38%
St. Paul	CEMVP	218.65	14.4	233.05	94%	6%
Rock Island	CEMVR	441.3	110	551.3	80%	20%
St. Louis	CEMVS	368.1	26	394.1	93%	7%

5 Conclusions and Recommendations

5.1 Conclusions

The waterways examined in this project handle hundreds of millions of tons of valuable commodities every year over more than 3,000 river miles. Safe navigation and situational awareness on these waterways are important to both mariners and the US supply chain. Understanding where AIS coverage gaps might result in radio communication blind spots is an important step in working to improve AIS transmit and receive capability in those areas. AIS coverage enables waterway stakeholders, including the USACE, to quantitatively examine the performance of the system, via metrics related to usage and congestion, which can then be used to make informed investment decisions.

The AIS coverage analysis results based on 2021 data were as follows:

- UMR: 837.4 mi (98%) had high coverage with 17.4 mi (2%) of low coverage. Table 3 presents the location details for high-coverage and low-coverage segments.
- Illinois River: 190.5 mi (59%) had high AIS coverage while 133 mi (41%) had low AIS coverage. Table 5 presents the contiguous sections of high-coverage and low-coverage river segments.
- Ohio River: 644 mi (66%) had high coverage, and 337 mi (34%) had low coverage. Table 7 presents the extent of contiguous sections of high or low coverage.

These coverage levels were based on conditions in 2021, which would reflect any deployments of mobile AIS stations that existed during the study period. The coverage levels presented in this report should be understood as a snapshot in time and are expected to fluctuate on subannual levels. It is known that individual towers have fluctuations in their availability and connectivity to the network; this can be due to network equipment outages, power outages, or damage from events such as lightning strikes.

5.2 Recommendations

In the future, this type of AIS coverage analysis could be expanded to other river systems not included in this report, such as the Tennessee River,

Arkansas River, Tennessee-Tombigbee Waterway, Snake River, or Columbia River. Additional methods for coverage analysis should be developed that can account for the presence of vessel-mounted equipment that can act as mobile towers to provide temporary terrestrial coverage. The presence of these mobile towers can skew reception coverage. Developing additional coverage analysis methods would allow for enhanced visibility into the current AIS coverage of terrestrial-AIS systems along major US inland waterways and subsequent availability of historical AIS data. If notable improvements to equipment are made, local before-and-after coverage examinations could be made to help verify the improvements yielded from an investment.

There are multiple options for improving terrestrial AIS coverage in areas with low or no coverage. Prioritization should be based on local safety priorities or hazard concerns (e.g., upcoming marine construction activity). Options for expanding coverage include the following:

- installing additional permanent towers in sites with electrical power and network connectivity
- adding repeater stations that relay signals to a larger base station
- raising antennas at an existing site to expand the area *seen* by the AIS equipment at that site
- temporarily deploying mobile trailer-mounted AIS towers in places where significant activity (e.g., construction) is planned

USACE navigation staff are encouraged to consider their current uses of AIS data, requirements for additional AIS coverage, and how improved or expanded AIS coverage may support their work. AIS data can benefit navigation operations work but also regulatory and environmental projects. Additional AIS sites may be installed either temporarily via a mobile platform or permanently if suitable locations can be secured. Suitable locations are generally elevated above the surrounding area (such as radio towers or bridges) and ideally have options for electrical power and network connectivity. USACE staff interested in expanding temporary or permanent AIS coverage in their district should contact the LOMA team via email (LomaAdmin@usace.army.mil).

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Appendix: Reach Level Transit Counts

A.1 Upper Mississippi River Transit Counts Per Reach in 2020 and 2021

Table A-1. Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVP_UM_SP_P02_8	846.8	843.5	630	651	619	614
CEMVP_UM_SP_P02_7	843.5	839.1	316	301	187	168
CEMVP_UM_SP_P02_6	839.1	836.2	662	673	508	500
CEMVP_UM_SP_P02_5	836.2	829.1	452	486	321	360
CEMVP_UM_SP_P02_4	829.1	825.9	597	601	435	442
CEMVP_UM_SP_P02_3	825.9	821.8	430	437	306	306
CEMVP_UM_SP_P02_2	821.8	816	423	426	341	346
CEMVP_UM_SP_P02_1	816	813.8	427	422	368	368
CEMVP_UM_SP_P03_5	813.8	808	459	454	418	427
CEMVP_UM_SP_P03_4	808	803.9	476	488	437	457
CEMVP_UM_SP_P03_3	803.9	801.1	490	496	462	471
CEMVP_UM_SP_P03_2	801.1	797.8	491	498	520	507
CEMVP_UM_SP_P03_1	797.8	795.8	452	452	398	400
CEMVP_UM_SP_P04_12	795.8	793.8	479	475	417	423
CEMVP_UM_SP_P04_11	793.8	789.2	443	451	375	380
CEMVP_UM_SP_P04_10	789.2	786.2	393	356	459	424
CEMVP_UM_SP_P04_9	786.2	782.8	283	237	248	180
CEMVP_UM_SP_P04_8	782.8	776.2	242	226	224	173
CEMVP_UM_SP_P04_7	776.2	770	389	417	367	388
CEMVP_UM_SP_P04_6	770	764.1	428	445	404	411
CEMVP_UM_SP_P04_5	764.1	761	451	464	413	432
CEMVP_UM_SP_P04_4	761	758.3	467	467	422	429
CEMVP_UM_SP_P04_3	758.3	755.5	472	468	423	437
CEMVP_UM_SP_P04_2	755.5	753.8	478	475	551	559
CEMVP_UM_SP_P04_1	753.8	752	466	464	439	428

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Channel Reach ID	Channel Reach ID	Channel Reach ID	Channel Reach ID	Channel Reach ID	Channel Reach ID
CEMVP_UM_SP_P05_5	752	750	589	592	549	554
CEMVP_UM_SP_P05_4	750	746	583	581	549	553
CEMVP_UM_SP_P05_3	746	741.8	575	579	537	555
CEMVP_UM_SP_P05_2	741.8	739.3	579	584	547	558
CEMVP_UM_SP_P05_1	739.3	737	488	507	513	524
CEMVP_UM_SP_P5A_3	737	733	509	509	560	565
CEMVP_UM_SP_P5A_2	733	729.8	510	509	563	562
CEMVP_UM_SP_P5A_1	729.8	727.8	492	496	503	494
CEMVP_UM_SP_P06_5	727.8	724.7	574	579	514	523
CEMVP_UM_SP_P06_4	724.7	721.6	634	646	575	592
CEMVP_UM_SP_P06_3	721.6	718.7	640	649	583	595
CEMVP_UM_SP_P06_2	718.7	715	650	653	597	598
CEMVP_UM_SP_P06_1	715	713	554	556	513	520
CEMVP_UM_SP_P07_5	713	709.6	689	686	863	870
CEMVP_UM_SP_P07_4	709.6	706.8	687	684	811	812
CEMVP_UM_SP_P07_3	706.8	704.8	692	688	613	614
CEMVP_UM_SP_P07_2	704.8	702.8	658	660	585	614
CEMVP_UM_SP_P07_1	702.8	701.8	685	716	570	610
CEMVP_UM_SP_P08_7	701.8	698	580	568	506	512
CEMVP_UM_SP_P08_6	698	694	511	543	479	495
CEMVP_UM_SP_P08_5	694	692	690	686	517	519
CEMVP_UM_SP_P08_4	692	689.6	562	550	494	488
CEMVP_UM_SP_P08_3	689.6	686	571	573	518	524
CEMVP_UM_SP_P08_2	686	681	562	555	512	519
CEMVP_UM_SP_P08_1	681	678.7	548	543	496	509
CEMVP_UM_SP_P09_9	678.7	677	543	525	500	501
CEMVP_UM_SP_P09_8	677	672	576	569	480	484
CEMVP_UM_SP_P09_7	672	670.4	583	579	491	491
CEMVP_UM_SP_P09_6	670.4	666.2	562	549	493	495
CEMVP_UM_SP_P09_5	666.2	663	534	530	487	482
CEMVP_UM_SP_P09_4	663	658	531	520	492	487

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVP_UM_SP_P09_3	658	653	553	541	506	516
CEMVP_UM_SP_P09_2	653	649	563	539	514	509
CEMVP_UM_SP_P09_1	649	647	548	531	500	504
CEMVP_UM_SP_P10_9	647	645	559	550	511	520
CEMVP_UM_SP_P10_8	645	642	557	544	509	516
CEMVP_UM_SP_P10_7	642	637	550	538	508	508
CEMVP_UM_SP_P10_6	637	632	534	520	502	492
CEMVP_UM_SP_P10_5	632	630	763	771	701	704
CEMVP_UM_SP_P10_4	630	626	782	783	689	679
CEMVP_UM_SP_P10_3	626	620	723	727	627	607
CEMVP_UM_SP_P10_2	620	616	669	668	598	591
CEMVP_UM_SP_P10_1	616	613.75	670	663	591	588
CEMVR_UM_11_MVR_1	614	613	696	682	610	609
CEMVR_UM_11_MVR_2	613	612	695	684	614	611
CEMVR_UM_11_MVR_3	612	611	689	680	607	598
CEMVR_UM_11_MVR_4	611	610	684	680	601	604
CEMVR_UM_11_MVR_5	610	609	677	677	606	604
CEMVR_UM_11_MVR_6	609	608	666	683	604	607
CEMVR_UM_11_MVR_7	608	607	682	697	606	617
CEMVR_UM_11_MVR_8	607	606	691	689	606	615
CEMVR_UM_11_MVR_9	606	605	684	682	605	599
CEMVR_UM_11_MVR_10	605	604	683	680	604	601
CEMVR_UM_11_MVR_11	604	603	669	669	602	595
CEMVR_UM_11_MVR_12	603	602	599	612	551	561
CEMVR_UM_11_MVR_13	602	601	553	511	480	481
CEMVR_UM_11_MVR_14	601	600	483	430	415	397
CEMVR_UM_11_MVR_15	600	599	468	421	420	384
CEMVR_UM_11_MVR_16	599	598	360	339	347	298
CEMVR_UM_11_MVR_17	598	597	326	329	304	275
CEMVR_UM_11_MVR_18	597	596	365	404	335	356
CEMVR_UM_11_MVR_19	596	595	448	544	427	520

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_11_MVR_20	595	594	560	653	501	638
CEMVR_UM_11_MVR_21	594	593	639	670	572	593
CEMVR_UM_11_MVR_22	593	592	660	677	583	607
CEMVR_UM_11_MVR_23	592	591	668	677	589	607
CEMVR_UM_11_MVR_24	591	590	693	692	613	615
CEMVR_UM_11_MVR_25	590	589	697	694	627	621
CEMVR_UM_11_MVR_26	589	588	692	692	634	633
CEMVR_UM_11_MVR_27	588	587	692	695	628	626
CEMVR_UM_11_MVR_28	587	586	690	688	627	623
CEMVR_UM_11_MVR_29	586	585	697	694	628	624
CEMVR_UM_11_MVR_30	585	584	697	695	631	633
CEMVR_UM_11_MVR_31	584	583	702	701	631	626
CEMVR_UM_12_MVR_1	583	582	720	749	673	757
CEMVR_UM_12_MVR_2	582	581	901	895	887	900
CEMVR_UM_12_MVR_3	581	580	871	818	771	846
CEMVR_UM_12_MVR_4	580	579	1504	1513	1425	1421
CEMVR_UM_12_MVR_5	579	578	1516	1535	1466	1467
CEMVR_UM_12_MVR_6	578	577	1387	1438	1201	1234
CEMVR_UM_12_MVR_7	577	576	1308	1357	1124	1144
CEMVR_UM_12_MVR_8	576	575	1350	1356	1222	1246
CEMVR_UM_12_MVR_9	575	574	642	629	585	569
CEMVR_UM_12_MVR_10	574	573	624	616	573	555
CEMVR_UM_12_MVR_11	573	572	669	682	595	599
CEMVR_UM_12_MVR_12	572	571	667	692	604	601
CEMVR_UM_12_MVR_13	571	570	271	294	274	239
CEMVR_UM_12_MVR_14	570	569	208	260	227	228
CEMVR_UM_12_MVR_15	569	568	529	594	481	566
CEMVR_UM_12_MVR_16	568	567	680	671	619	654
CEMVR_UM_12_MVR_17	567	566.1	690	682	639	657
CEMVR_UM_12_MVR_18	566.1	565	706	690	651	671
CEMVR_UM_12_MVR_19	565	564	716	695	651	670

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_12_MVR_20	564	563	712	695	659	664
CEMVR_UM_12_MVR_21	563	562	703	691	670	680
CEMVR_UM_12_MVR_22	562	561	700	673	674	680
CEMVR_UM_12_MVR_23	561	560	700	670	666	664
CEMVR_UM_12_MVR_24	560	559	709	680	670	667
CEMVR_UM_12_MVR_25	559	558	700	682	673	672
CEMVR_UM_12_MVR_26	558	556.7	704	687	675	674
CEMVR_UM_13_MVR_1	556.7	555	695	684	666	673
CEMVR_UM_13_MVR_2	555	554	689	678	662	667
CEMVR_UM_13_MVR_3	554	553	684	670	651	666
CEMVR_UM_13_MVR_4	553	552	684	678	648	662
CEMVR_UM_13_MVR_5	552	551	680	677	639	663
CEMVR_UM_13_MVR_6	551	550	674	672	633	663
CEMVR_UM_13_MVR_7	550	549	678	669	634	660
CEMVR_UM_13_MVR_8	549	548	679	668	641	657
CEMVR_UM_13_MVR_9	548	547	688	676	644	665
CEMVR_UM_13_MVR_10	547	546	674	665	636	658
CEMVR_UM_13_MVR_11	546	545	662	662	626	656
CEMVR_UM_13_MVR_12	545	544	668	658	638	658
CEMVR_UM_13_MVR_13	544	543	670	664	644	666
CEMVR_UM_13_MVR_14	543	542	683	711	637	650
CEMVR_UM_13_MVR_15	542	541	684	709	623	634
CEMVR_UM_13_MVR_16	541	540	616	637	568	564
CEMVR_UM_13_MVR_17	540	539	629	640	571	572
CEMVR_UM_13_MVR_18	539	538	730	726	627	650
CEMVR_UM_13_MVR_19	538	537	717	725	620	634
CEMVR_UM_13_MVR_20	537	536	827	868	792	816
CEMVR_UM_13_MVR_21	536	535	890	922	863	855
CEMVR_UM_13_MVR_22	535	534	743	743	664	667
CEMVR_UM_13_MVR_23	534	533	728	732	649	635
CEMVR_UM_13_MVR_24	533	532	737	736	710	697

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_13_MVR_25	532	531	755	741	739	731
CEMVR_UM_13_MVR_26	531	530	808	798	745	732
CEMVR_UM_13_MVR_27	530	529	743	736	665	667
CEMVR_UM_13_MVR_28	529	528	738	738	666	665
CEMVR_UM_13_MVR_29	528	527	0	0	0	0
CEMVR_UM_13_MVR_32	525	524	753	739	677	674
CEMVR_UM_13_MVR_33	524	522.6	751	729	678	669
CEMVR_UM_14_MVR_1	522.6	521	752	740	737	719
CEMVR_UM_14_MVR_2	521	520	744	743	709	702
CEMVR_UM_14_MVR_3	520	519	750	744	692	699
CEMVR_UM_14_MVR_4	519	518	755	740	686	684
CEMVR_UM_14_MVR_5	518	517	816	761	714	680
CEMVR_UM_14_MVR_6	517	516	992	812	718	629
CEMVR_UM_14_MVR_7	516	515	749	731	409	412
CEMVR_UM_14_MVR_8	515	514	724	715	408	419
CEMVR_UM_14_MVR_9	514	513	1055	970	750	751
CEMVR_UM_14_MVR_10	513	512	884	787	688	652
CEMVR_UM_14_MVR_11	512	511	951	949	806	803
CEMVR_UM_14_MVR_12	511	510	915	920	706	757
CEMVR_UM_14_MVR_13	510	509	911	953	683	823
CEMVR_UM_14_MVR_14	509	508	1006	1007	868	935
CEMVR_UM_14_MVR_15	508	507	1025	1018	882	907
CEMVR_UM_14_MVR_16	507	506	1033	1014	877	857
CEMVR_UM_14_MVR_17	506	505	1015	1000	851	853
CEMVR_UM_14_MVR_18	505	504	1020	1009	879	976
CEMVR_UM_14_MVR_19	504	502.8	1001	983	835	866
CEMVR_UM_14_MVR_20	502.8	502	987	979	809	842
CEMVR_UM_14_MVR_21	502	501	1031	1020	838	897
CEMVR_UM_14_MVR_22	501	500	1054	1038	939	966
CEMVR_UM_14_MVR_23	500	499	1064	1050	972	982
CEMVR_UM_14_MVR_24	499	498	1071	1047	977	983

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_14_MVR_25	498	497	1065	1048	980	990
CEMVR_UM_14_MVR_26	497	495.9	970	960	910	918
CEMVR_UM_14_MVR_27	495.9	494.9	971	960	902	920
CEMVR_UM_14_MVR_28	494.9	493.4	979	960	915	927
CEMVR_UM_15_MVR_1	493.4	492	978	974	899	910
CEMVR_UM_15_MVR_2	492	491	982	975	900	914
CEMVR_UM_15_MVR_3	491	490	986	980	909	921
CEMVR_UM_15_MVR_4	490	489	982	978	901	928
CEMVR_UM_15_MVR_5	489	488	993	992	934	967
CEMVR_UM_15_MVR_6	488	487	1021	1021	979	997
CEMVR_UM_15_MVR_7	487	486	865	851	798	788
CEMVR_UM_15_MVR_8	486	485	951	947	925	959
CEMVR_UM_15_MVR_9	485	484	951	947	928	937
CEMVR_UM_15_MVR_10	484	483.1	895	886	822	799
CEMVR_UM_16_MVR_1	483.1	482	963	955	838	848
CEMVR_UM_16_MVR_2	482	481	890	866	774	772
CEMVR_UM_16_MVR_3	481	480	999	1019	943	957
CEMVR_UM_16_MVR_4	480	479	1002	1032	921	954
CEMVR_UM_16_MVR_5	479	478	984	1027	912	953
CEMVR_UM_16_MVR_6	478	477	989	1019	929	965
CEMVR_UM_16_MVR_7	477	476	995	1026	922	953
CEMVR_UM_16_MVR_8	476	475	1253	1294	1100	1127
CEMVR_UM_16_MVR_9	475	474	2413	2435	2220	2247
CEMVR_UM_16_MVR_10	474	473	1516	1541	1347	1388
CEMVR_UM_16_MVR_11	473	472	1488	1536	1261	1310
CEMVR_UM_16_MVR_12	472	471	1394	1429	1255	1310
CEMVR_UM_16_MVR_13	471	470	1270	1273	1058	1097
CEMVR_UM_16_MVR_14	470	469	858	861	721	747
CEMVR_UM_16_MVR_15	469	468	857	864	727	758
CEMVR_UM_16_MVR_16	468	467	845	866	727	763
CEMVR_UM_16_MVR_17	467	466	855	861	732	756

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_16_MVR_18	466	465	854	861	738	753
CEMVR_UM_16_MVR_19	465	464	853	855	740	762
CEMVR_UM_16_MVR_20	464	463	865	857	740	761
CEMVR_UM_16_MVR_21	463	462	862	851	740	761
CEMVR_UM_16_MVR_22	462	461	857	849	738	763
CEMVR_UM_16_MVR_23	461	460	854	842	734	761
CEMVR_UM_16_MVR_24	460	459	838	830	738	756
CEMVR_UM_16_MVR_25	459	458	838	834	743	759
CEMVR_UM_16_MVR_26	458	457.2	861	858	754	765
CEMVR_UM_17_MVR_1	457.2	456	1154	1191	990	1042
CEMVR_UM_17_MVR_2	456	455	1131	1178	967	1033
CEMVR_UM_17_MVR_3	455	454	1166	1167	979	1010
CEMVR_UM_17_MVR_4	454	453	1014	1024	889	905
CEMVR_UM_17_MVR_5	453	452	994	1007	863	881
CEMVR_UM_17_MVR_6	452	451	946	957	828	846
CEMVR_UM_17_MVR_7	451	450	845	830	704	723
CEMVR_UM_17_MVR_8	450	449	805	817	687	708
CEMVR_UM_17_MVR_9	449	448	811	816	688	712
CEMVR_UM_17_MVR_10	448	447	860	875	694	710
CEMVR_UM_17_MVR_11	447	446	833	841	683	707
CEMVR_UM_17_MVR_12	446	445	811	816	680	698
CEMVR_UM_17_MVR_13	445	444	813	816	687	698
CEMVR_UM_17_MVR_14	444	443	810	816	689	702
CEMVR_UM_17_MVR_15	443	442	812	820	690	707
CEMVR_UM_17_MVR_16	442	441	809	819	685	704
CEMVR_UM_17_MVR_17	441	440	808	815	685	700
CEMVR_UM_17_MVR_18	440	439	817	826	686	706
CEMVR_UM_17_MVR_19	439	438	815	825	690	705
CEMVR_UM_17_MVR_20	438	437.1	879	857	714	722
CEMVR_UM_18_MVR_1	437.1	436	832	839	693	712
CEMVR_UM_18_MVR_2	436	435	820	825	684	706

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_18_MVR_3	435	434	816	814	677	694
CEMVR_UM_18_MVR_4	434	433	807	810	675	686
CEMVR_UM_18_MVR_5	433	432	976	990	833	859
CEMVR_UM_18_MVR_6	432	431	956	989	810	846
CEMVR_UM_18_MVR_7	431	430	914	955	770	810
CEMVR_UM_18_MVR_8	430	429	1094	1165	979	1020
CEMVR_UM_18_MVR_9	429	428	1148	1200	1005	1047
CEMVR_UM_18_MVR_10	428	427	799	825	657	695
CEMVR_UM_18_MVR_11	427	426	829	829	685	701
CEMVR_UM_18_MVR_12	426	425	818	820	677	702
CEMVR_UM_18_MVR_13	425	424	819	833	696	712
CEMVR_UM_18_MVR_14	424	423	823	842	692	716
CEMVR_UM_18_MVR_15	423	422	832	837	693	715
CEMVR_UM_18_MVR_16	422	421	833	829	695	719
CEMVR_UM_18_MVR_17	421	420	825	827	689	718
CEMVR_UM_18_MVR_18	420	419	829	827	693	712
CEMVR_UM_18_MVR_19	419	418	841	831	688	707
CEMVR_UM_18_MVR_20	418	417	1390	1391	1165	1185
CEMVR_UM_18_MVR_21	417	416	1402	1404	1191	1205
CEMVR_UM_18_MVR_22	416	415	869	876	722	736
CEMVR_UM_18_MVR_23	415	414	877	876	727	736
CEMVR_UM_18_MVR_24	414	413	876	880	725	737
CEMVR_UM_18_MVR_25	413	412	883	886	727	740
CEMVR_UM_18_MVR_26	412	410.5	884	892	735	750
CEMVR_UM_19_MVR_1	410.5	409	921	932	762	773
CEMVR_UM_19_MVR_2	409	408	1226	1227	983	1011
CEMVR_UM_19_MVR_3	408	407	1222	1228	975	1012
CEMVR_UM_19_MVR_4	407	406	1407	1433	1162	1194
CEMVR_UM_19_MVR_5	406	405	1644	1631	1337	1362
CEMVR_UM_19_MVR_6	405	404	1495	1458	1309	1311
CEMVR_UM_19_MVR_7	404	403	980	991	798	802

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_19_MVR_8	403	402	872	891	749	757
CEMVR_UM_19_MVR_9	402	401	876	896	740	758
CEMVR_UM_19_MVR_10	401	400	867	901	732	750
CEMVR_UM_19_MVR_11	400	399	857	900	727	743
CEMVR_UM_19_MVR_12	399	398	863	883	725	741
CEMVR_UM_19_MVR_13	398	397	891	878	728	718
CEMVR_UM_19_MVR_14	397	396	793	786	650	635
CEMVR_UM_19_MVR_15	396	395	764	734	620	573
CEMVR_UM_19_MVR_16	395	394	744	728	624	580
CEMVR_UM_19_MVR_17	394	392.9	505	485	343	327
CEMVR_UM_19_MVR_18	392.9	391.9	425	422	267	275
CEMVR_UM_19_MVR_19	391.9	391	385	467	243	321
CEMVR_UM_19_MVR_20	391	390	450	506	310	349
CEMVR_UM_19_MVR_21	390	389	555	500	420	333
CEMVR_UM_19_MVR_22	389	388	294	284	192	171
CEMVR_UM_19_MVR_23	388	387	302	275	208	196
CEMVR_UM_19_MVR_24	387	386	434	374	330	290
CEMVR_UM_19_MVR_25	386	385	707	674	524	516
CEMVR_UM_19_MVR_26	385	384	503	815	407	630
CEMVR_UM_19_MVR_27	384	383	538	848	438	652
CEMVR_UM_19_MVR_28	383	382	904	957	729	733
CEMVR_UM_19_MVR_29	382	381	625	786	513	654
CEMVR_UM_19_MVR_30	381	380	682	870	571	748
CEMVR_UM_19_MVR_31	380	379	663	828	510	708
CEMVR_UM_19_MVR_32	379	378	667	833	502	729
CEMVR_UM_19_MVR_33	378	377	838	911	676	827
CEMVR_UM_19_MVR_34	377	376	859	887	723	772
CEMVR_UM_19_MVR_35	376	375	878	900	750	779
CEMVR_UM_19_MVR_36	375	374	888	892	752	774
CEMVR_UM_19_MVR_37	374	373	881	895	752	770
CEMVR_UM_19_MVR_38	373	372	876	897	762	766

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_19_MVR_39	372	371	891	906	762	774
CEMVR_UM_19_MVR_40	371	370	907	934	756	782
CEMVR_UM_19_MVR_41	370	369	911	926	761	779
CEMVR_UM_19_MVR_42	369	368	918	922	757	780
CEMVR_UM_19_MVR_43	368	367	916	923	761	779
CEMVR_UM_19_MVR_44	367	366	916	916	758	777
CEMVR_UM_19_MVR_45	366	365	1530	1539	1304	1323
CEMVR_UM_19_MVR_46	365	364.5	1696	1711	1400	1435
CEMVR_UM_20_MVR_1	364.5	363	921	923	760	772
CEMVR_UM_20_MVR_2	363	362	927	946	748	777
CEMVR_UM_20_MVR_3	362	361	1132	1166	930	972
CEMVR_UM_20_MVR_4	361	360	1117	1165	931	962
CEMVR_UM_20_MVR_5	360	359	924	952	749	781
CEMVR_UM_20_MVR_6	359	358	928	955	750	778
CEMVR_UM_20_MVR_7	358	357	923	937	729	767
CEMVR_UM_20_MVR_8	357	356	923	935	731	761
CEMVR_UM_20_MVR_9	356	355	936	947	748	776
CEMVR_UM_20_MVR_10	355	354	944	952	746	782
CEMVR_UM_20_MVR_11	354	353	952	953	739	780
CEMVR_UM_20_MVR_12	353	352	944	951	735	771
CEMVR_UM_20_MVR_13	352	351	947	954	743	769
CEMVR_UM_20_MVR_14	351	350	935	953	739	771
CEMVR_UM_20_MVR_15	350	349	930	939	737	752
CEMVR_UM_20_MVR_16	349	348	927	934	738	757
CEMVR_UM_20_MVR_17	348	347	931	943	738	777
CEMVR_UM_20_MVR_18	347	346	948	940	751	779
CEMVR_UM_20_MVR_19	346	345	1153	1143	908	946
CEMVR_UM_20_MVR_20	345	343.2	1185	1165	956	992
CEMVR_UM_21_MVR_1	343.2	342	1165	1166	963	984
CEMVR_UM_21_MVR_2	342	341	1268	1294	1083	1109
CEMVR_UM_21_MVR_3	341	340	1144	1142	964	992

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_21_MVR_4	340	339	1140	1139	960	987
CEMVR_UM_21_MVR_5	339	338	1130	1136	958	993
CEMVR_UM_21_MVR_6	338	337	1126	1136	954	985
CEMVR_UM_21_MVR_7	337	336	1136	1137	956	974
CEMVR_UM_21_MVR_8	336	335	1128	1132	950	970
CEMVR_UM_21_MVR_9	335	334	1179	1198	1026	1041
CEMVR_UM_21_MVR_10	334	333	1180	1190	1019	1036
CEMVR_UM_21_MVR_11	333	332	1185	1191	1022	1040
CEMVR_UM_21_MVR_12	332	331	1201	1203	1027	1038
CEMVR_UM_21_MVR_13	331	330	1188	1188	1029	1048
CEMVR_UM_21_MVR_14	330	329	1188	1184	1021	1054
CEMVR_UM_21_MVR_15	329	328	1187	1169	1021	1053
CEMVR_UM_21_MVR_16	328	327	1277	1265	1161	1186
CEMVR_UM_21_MVR_17	327	326	1606	1669	1547	1601
CEMVR_UM_21_MVR_18	326	324.8	1886	1891	1619	1629
CEMVR_UM_22_MVR_1	324.8	324	1085	1089	931	962
CEMVR_UM_22_MVR_2	324	323	1068	1082	919	954
CEMVR_UM_22_MVR_3	323	322	1064	1067	913	947
CEMVR_UM_22_MVR_4	322	321	1058	1078	922	949
CEMVR_UM_22_MVR_5	321	320	1007	1018	848	875
CEMVR_UM_22_MVR_6	320	319	978	992	834	859
CEMVR_UM_22_MVR_7	319	318	965	988	817	853
CEMVR_UM_22_MVR_8	318	317	928	970	808	847
CEMVR_UM_22_MVR_9	317	316	938	972	820	848
CEMVR_UM_22_MVR_10	316	315	976	1000	827	850
CEMVR_UM_22_MVR_11	315	314	978	1003	829	844
CEMVR_UM_22_MVR_12	314	313	959	992	830	844
CEMVR_UM_22_MVR_13	313	312	963	995	822	857
CEMVR_UM_22_MVR_14	312	311	958	989	840	862
CEMVR_UM_22_MVR_15	311	310	972	990	863	877
CEMVR_UM_22_MVR_16	310	309	1186	1219	1062	1088

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_UM_22_MVR_17	309	308	2235	2318	2220	2256
CEMVR_UM_22_MVR_18	308	307	1698	1740	1647	1670
CEMVR_UM_22_MVR_19	307	306	1506	1582	1214	1260
CEMVR_UM_22_MVR_20	306	305	1133	1170	858	884
CEMVR_UM_22_MVR_21	305	304	1024	1064	865	892
CEMVR_UM_22_MVR_22	304	303	1049	1068	877	891
CEMVR_UM_22_MVR_23	303	302	1068	1070	886	897
CEMVR_UM_22_MVR_24	302	301.2	0	0	0	0
CEMVS_UM_SL_P24_2	301.1	286	0	0	0	0
CEMVS_UM_SL_P24_1	286	273.5	928	943	769	779
CEMVS_UM_SL_P25_5	273.5	258.25	923	874	743	765
CEMVS_UM_SL_P25_4	258.25	252.6	781	826	738	783
CEMVS_UM_SL_P25_3	252.6	247.2	753	826	779	819
CEMVS_UM_SL_P25_2	247.2	241.5	786	857	799	824
CEMVS_UM_SL_P26_6	241.5	239	853	954	810	828
CEMVS_UM_SL_P26_5	239	229.75	346	618	480	595
CEMVS_UM_SL_P26_3	229.75	217.9	660	866	708	777
CEMVS_UM_SL_P26_2	217.9	205.2	1306	1505	1579	1674
CEMVS_UM_SL_P26_1	205.2	200.75	1642	1658	1751	1755
CEMVS_UM_SL_MRC_4	200.75	198	1640	1660	1848	1754
CEMVS_UM_SL_MRC_1	198	184	0	1	132	121
CEMVS_UM_SL_MRC_3	194	184	1897	1617	1895	1579
CEMVS_UM_SL_ILC_6	184	180	3133	3176	2858	2860
CEMVS_UM_SL_ILC_5	180	174	3645	3731	3394	3396
CEMVS_UM_SL_ILC_4	174	170	2607	2661	2462	2501
CEMVS_UM_SL_ILC_3	170	165	2194	2233	2204	2214
CEMVS_UM_SL_ILC_2	165	160	1877	1934	1932	1908
CEMVS_UM_SL_ILC_1	160	154	1929	1972	1942	1932
CEMVS_UM_SL_PRC_3	154	146.5	1929	1947	1891	1872
CEMVS_UM_SL_PRC_2	146.5	144	1802	1865	1787	1796
CEMVS_UM_SL_PRC_1	144	140	1826	1900	1846	1871

Table A-1. (cont.). Upper Mississippi River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVS_UM_SL_FCC_2	140	131	1793	1856	1832	1830
CEMVS_UM_SL_FCC_1	131	125	1748	1846	1826	1863
CEMVS_UM_SL_KBC_2	125	117.4	1910	2022	1969	2044
CEMVS_UM_SL_KBC_1	117.4	112	1748	1879	1713	1805
CEMVS_UM_SL_CRC_1	112	103	1539	1558	1372	1493
CEMVS_UM_SL_RRC_2	103	94.8	675	615	980	1065
CEMVS_UM_SL_RRC_1	94.8	90	192	127	768	896
CEMVS_UM_SL_GTC_5	90	85	151	109	914	982
CEMVS_UM_SL_GTC_4	85	79	19	11	1067	1019
CEMVS_UM_SL_GTC_3	79	73.8	7	1	1013	1029
CEMVS_UM_SL_GTC_2	73.8	71.25	11	5	836	947
CEMVS_UM_SL_GTC_1	71.25	67	24	16	624	799
CEMVS_UM_SL_DIC_6	67	63	12	6	629	744
CEMVS_UM_SL_DIC_5	63	57	0	3	879	945
CEMVS_UM_SL_DIC_4	57	51	4	5	959	981
CEMVS_UM_SL_DIC_3	51	47.75	9	19	1233	1235
CEMVS_UM_SL_DIC_2	47.75	43	11	11	1053	1063
CEMVS_UM_SL_DIC_1	43	40	21	15	1035	1065
CEMVS_UM_SL_DBC_5	40	37	52	43	898	939
CEMVS_UM_SL_DBC_4	37	33	67	67	858	911
CEMVS_UM_SL_DBC_3	33	29	522	667	537	771
CEMVS_UM_SL_DBC_2	29	25	693	955	679	1004
CEMVS_UM_SL_DBC_1	25	20	1571	1667	1571	1775
CEMVS_UM_SL_EPC_5	20	16.75	1522	1659	1581	1818
CEMVS_UM_SL_EPC_4	16.75	12	1615	1705	1777	1915
CEMVS_UM_SL_EPC_3	12	10.25	1842	1896	1935	2001
CEMVS_UM_SL_EPC_2	10.25	6	1932	1963	1977	2058
CEMVS_UM_SL_EPC_1	6	0	1876	1948	1941	2026

A.2 Illinois River Transit Counts Per Reach 2020 and 2021

Table A-2. Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVS_IL_SL_IL1_1	2	12	872	922	1019	935
CEMVS_IL_SL_IL1_2	12	18	230	356	716	701
CEMVS_IL_SL_IL1_3	18	22.75	153	234	655	641
CEMVS_IL_SL_IL1_4	22.75	28.5	79	86	631	598
CEMVS_IL_SL_IL2_1	28.5	38.2	43	39	582	559
CEMVS_IL_SL_IL2_2	38.2	44.1	53	50	579	561
CEMVS_IL_SL_IL2_3	44.1	70.1	77	72	285	364
CEMVS_IL_SL_IL2_4	70.1	85	1157	10535	1422	55772
CEMVR_IL_LA_MVR_6	85	86	996	2380	431	3158
CEMVR_IL_LA_MVR_7	86	87	882	890	370	342
CEMVR_IL_LA_MVR_8	87	88	1126	1130	458	454
CEMVR_IL_LA_MVR_9	88	89	1173	1211	408	460
CEMVR_IL_LA_MVR_10	89	90	1033	1084	245	328
CEMVR_IL_LA_MVR_11	90	91	982	998	232	281
CEMVR_IL_LA_MVR_12	91	92	697	720	85	133
CEMVR_IL_LA_MVR_13	92	93	682	686	71	83
CEMVR_IL_LA_MVR_14	93	94	685	690	82	102
CEMVR_IL_LA_MVR_15	94	95	677	676	41	53
CEMVR_IL_LA_MVR_16	95	96	658	661	32	33
CEMVR_IL_LA_MVR_17	96	97	644	658	41	45
CEMVR_IL_LA_MVR_18	97	98	458	566	22	24
CEMVR_IL_LA_MVR_19	98	99	455	561	18	19
CEMVR_IL_LA_MVR_20	99	100	507	573	19	21
CEMVR_IL_LA_MVR_21	100	101	359	455	11	20
CEMVR_IL_LA_MVR_22	101	102	189	261	12	22
CEMVR_IL_LA_MVR_23	102	103	199	267	19	29
CEMVR_IL_LA_MVR_24	103	104	233	331	19	29
CEMVR_IL_LA_MVR_25	104	105	118	214	17	27
CEMVR_IL_LA_MVR_26	105	106	55	107	18	15
CEMVR_IL_LA_MVR_27	106	107	73	158	18	17
CEMVR_IL_LA_MVR_28	107	108	171	307	34	31
CEMVR_IL_LA_MVR_29	108	109	102	157	40	41
CEMVR_IL_LA_MVR_30	109	110	7	6	15	21
CEMVR_IL_LA_MVR_31	110	111	8	4	18	20
CEMVR_IL_LA_MVR_32	111	112	14	31	32	27

Table A-2 (cont.). Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_IL_LA_MVR_33	112	113	10	14	23	14
CEMVR_IL_LA_MVR_34	113	114	9	11	22	16
CEMVR_IL_LA_MVR_35	114	115	14	20	33	24
CEMVR_IL_LA_MVR_36	115	116	27	40	46	48
CEMVR_IL_LA_MVR_37	116	117	31	56	39	35
CEMVR_IL_LA_MVR_38	117	118	28	53	27	23
CEMVR_IL_LA_MVR_39	118	119	44	64	35	27
CEMVR_IL_LA_MVR_40	119	120	19	24	51	45
CEMVR_IL_LA_MVR_41	120	121	7	3	25	23
CEMVR_IL_LA_MVR_42	121	122	6	5	30	28
CEMVR_IL_LA_MVR_43	122	123	6	9	30	26
CEMVR_IL_LA_MVR_44	123	124	9	10	43	39
CEMVR_IL_LA_MVR_45	124	125	7	12	41	49
CEMVR_IL_LA_MVR_46	125	126	6	7	28	27
CEMVR_IL_LA_MVR_47	126	127	12	13	25	27
CEMVR_IL_LA_MVR_48	127	128	12	7	20	23
CEMVR_IL_LA_MVR_49	128	129	8	7	30	21
CEMVR_IL_LA_MVR_50	129	130	11	7	29	29
CEMVR_IL_LA_MVR_51	130	131	51	23	60	43
CEMVR_IL_LA_MVR_52	131	132	66	20	73	44
CEMVR_IL_LA_MVR_53	132	133	15	5	24	18
CEMVR_IL_LA_MVR_54	133	134	18	12	29	26
CEMVR_IL_LA_MVR_55	134	135	283	199	265	170
CEMVR_IL_LA_MVR_56	135	136	268	195	270	180
CEMVR_IL_LA_MVR_57	136	137	93	72	104	79
CEMVR_IL_LA_MVR_58	137	138	104	89	54	60
CEMVR_IL_LA_MVR_59	138	139	46	22	28	28
CEMVR_IL_LA_MVR_60	139	140	33	24	26	34
CEMVR_IL_LA_MVR_61	140	141	185	100	90	57
CEMVR_IL_LA_MVR_62	141	142	121	46	73	46
CEMVR_IL_LA_MVR_63	142	143	93	34	85	48
CEMVR_IL_LA_MVR_64	143	144	166	99	135	102
CEMVR_IL_LA_MVR_65	144	145	493	405	390	312
CEMVR_IL_LA_MVR_66	145	146	304	238	223	162
CEMVR_IL_LA_MVR_67	146	147	340	264	282	227
CEMVR_IL_LA_MVR_68	147	148	905	890	977	993

Table A-2 (cont.). Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_IL_LA_MVR_69	148	149	971	967	1111	1087
CEMVR_IL_LA_MVR_70	149	150	982	977	1119	1082
CEMVR_IL_LA_MVR_71	150	151	981	976	1122	1102
CEMVR_IL_LA_MVR_72	151	152	1463	1406	1618	1546
CEMVR_IL_LA_MVR_73	152	153	1032	1046	1240	1207
CEMVR_IL_LA_MVR_74	153	154	1049	1036	1254	1185
CEMVR_IL_LA_MVR_75	154	155	960	946	1199	1124
CEMVR_IL_LA_MVR_76	155	156	961	939	1227	1107
CEMVR_IL_LA_MVR_77	156	157	960	953	1227	1116
CEMVR_IL_LA_MVR_78	157	157.8	967	945	1251	1120
CEMVR_IL_PE_MVR_1	157.8	159	1223	1244	1806	1721
CEMVR_IL_PE_MVR_2	159	160	2399	2379	2994	2895
CEMVR_IL_PE_MVR_3	160	161	1432	1421	1681	1616
CEMVR_IL_PE_MVR_4	161	162	907	890	1112	1073
CEMVR_IL_PE_MVR_5	162	163	903	877	1049	1043
CEMVR_IL_PE_MVR_6	163	164	924	900	1146	1137
CEMVR_IL_PE_MVR_7	164	165	913	899	1117	1107
CEMVR_IL_PE_MVR_8	165	166.1	867	889	1049	1094
CEMVR_IL_PE_MVR_9	166.1	167	542	593	624	717
CEMVR_IL_PE_MVR_10	167	168	63	115	45	110
CEMVR_IL_PE_MVR_11	168	169	54	109	41	101
CEMVR_IL_PE_MVR_12	169	170	152	245	164	285
CEMVR_IL_PE_MVR_13	170	171	169	271	199	323
CEMVR_IL_PE_MVR_14	171	172	271	385	384	509
CEMVR_IL_PE_MVR_15	172	173	132	287	245	426
CEMVR_IL_PE_MVR_16	173	174	71	162	107	192
CEMVR_IL_PE_MVR_17	174	175	63	102	91	133
CEMVR_IL_PE_MVR_18	175	176	14	40	36	70
CEMVR_IL_PE_MVR_19	176	177	2	11	19	25
CEMVR_IL_PE_MVR_20	177	178	4	16	17	27
CEMVR_IL_PE_MVR_21	178	179	6	18	23	37
CEMVR_IL_PE_MVR_22	179	180	2	#N/A	14	16
CEMVR_IL_PE_MVR_23	180	181	#N/A	#N/A	5	9
CEMVR_IL_PE_MVR_24	181	182	2	#N/A	8	5
CEMVR_IL_PE_MVR_25	182	183	2	#N/A	4	6
CEMVR_IL_PE_MVR_26	183	184	1	#N/A	1	7

Table A-2 (cont.). Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_IL_PE_MVR_27	184	185	#N/A	#N/A	3	9
CEMVR_IL_PE_MVR_28	185	186	#N/A	#N/A	8	12
CEMVR_IL_PE_MVR_29	186	187	#N/A	#N/A	6	8
CEMVR_IL_PE_MVR_30	187	188	#N/A	#N/A	8	10
CEMVR_IL_PE_MVR_31	188	189	#N/A	1	11	23
CEMVR_IL_PE_MVR_32	189	190	2	1	8	16
CEMVR_IL_PE_MVR_33	190	191	2	#N/A	8	17
CEMVR_IL_PE_MVR_34	191	192	2	1	10	20
CEMVR_IL_PE_MVR_35	192	193	1	2	10	18
CEMVR_IL_PE_MVR_36	193	194	1	2	7	12
CEMVR_IL_PE_MVR_37	194	195	1	3	8	8
CEMVR_IL_PE_MVR_38	195	196	#N/A	1	4	6
CEMVR_IL_PE_MVR_39	196	197	#N/A	#N/A	4	3
CEMVR_IL_PE_MVR_40	197	198	1	#N/A	4	5
CEMVR_IL_PE_MVR_41	198	199	1	#N/A	8	4
CEMVR_IL_PE_MVR_42	199	200	2	#N/A	3	7
CEMVR_IL_PE_MVR_43	200	201	1	#N/A	1	7
CEMVR_IL_PE_MVR_44	201	202	1	#N/A	2	5
CEMVR_IL_PE_MVR_45	202	203	#N/A	#N/A	2	1
CEMVR_IL_PE_MVR_46	203	204	1	2	5	3
CEMVR_IL_PE_MVR_47	204	205	2	2	10	7
CEMVR_IL_PE_MVR_48	205	206	4	2	8	8
CEMVR_IL_PE_MVR_49	206	207	2	#N/A	25	31
CEMVR_IL_PE_MVR_50	207	208	1	#N/A	13	18
CEMVR_IL_PE_MVR_51	208	209	#N/A	1	12	17
CEMVR_IL_PE_MVR_52	209	210	1	#N/A	6	13
CEMVR_IL_PE_MVR_53	210	211	57	57	19	30
CEMVR_IL_PE_MVR_54	211	212	657	518	415	266
CEMVR_IL_PE_MVR_55	212	213	758	627	634	424
CEMVR_IL_PE_MVR_56	213	214	739	643	601	454
CEMVR_IL_PE_MVR_57	214	215	709	605	519	383
CEMVR_IL_PE_MVR_58	215	216	750	674	549	440
CEMVR_IL_PE_MVR_59	216	217	822	752	683	532
CEMVR_IL_PE_MVR_60	217	218	914	895	992	947
CEMVR_IL_PE_MVR_61	218	219	1059	1045	1098	1097
CEMVR_IL_PE_MVR_62	219	220	1262	1250	1230	1213

Table A-2 (cont.). Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_IL_PE_MVR_63	220	221	1251	1250	1257	1230
CEMVR_IL_PE_MVR_64	221	222	1577	1577	1840	1821
CEMVR_IL_PE_MVR_65	222	223	1412	1404	1515	1498
CEMVR_IL_PE_MVR_66	223	224	1568	1455	1515	1408
CEMVR_IL_PE_MVR_67	224	225	1004	982	1136	1102
CEMVR_IL_PE_MVR_68	225	226	1009	986	1161	1111
CEMVR_IL_PE_MVR_69	226	227	1009	1002	1176	1117
CEMVR_IL_PE_MVR_70	227	228	1004	998	1195	1112
CEMVR_IL_PE_MVR_71	228	229	1007	988	1212	1102
CEMVR_IL_PE_MVR_72	229	230	801	799	1028	900
CEMVR_IL_PE_MVR_73	230	231	822	816	1035	910
CEMVR_IL_SR_MVR_1	231	232	894	872	1074	935
CEMVR_IL_SR_MVR_2	232	233	893	865	1046	934
CEMVR_IL_SR_MVR_3	233	234	892	869	1027	927
CEMVR_IL_SR_MVR_4	234	235	888	870	1038	937
CEMVR_IL_SR_MVR_5	235	236	894	877	1027	933
CEMVR_IL_SR_MVR_6	236	237	851	848	958	906
CEMVR_IL_SR_MVR_7	237	238	1457	1467	1501	1500
CEMVR_IL_SR_MVR_8	238	239	1204	1162	1277	1250
CEMVR_IL_SR_MVR_9	239	240	1187	1169	1299	1238
CEMVR_IL_SR_MVR_10	240	241	1191	1182	1324	1237
CEMVR_IL_SR_MVR_11	241	242	1194	1183	1344	1233
CEMVR_IL_SR_MVR_12	242	243	1031	1029	1169	1118
CEMVR_IL_SR_MVR_13	243	244.5	827	817	1003	873
CEMVR_IL_MA_MVR_1	244.5	246	845	832	1034	916
CEMVR_IL_MA_MVR_2	246	247	829	822	1025	911
CEMVR_IL_MA_MVR_3	247	248	820	825	1003	907
CEMVR_IL_MA_MVR_4	248	249	947	955	1060	991
CEMVR_IL_MA_MVR_5	249	250	968	982	1128	1069
CEMVR_IL_MA_MVR_6	250	251	1181	1192	1307	1276
CEMVR_IL_MA_MVR_7	251	252	1171	1189	1271	1276
CEMVR_IL_MA_MVR_8	252	253	1147	1181	1287	1291
CEMVR_IL_MA_MVR_9	253	254	909	1022	1030	1134
CEMVR_IL_MA_MVR_10	254	255	748	779	831	844
CEMVR_IL_MA_MVR_11	255	256	742	768	830	830
CEMVR_IL_MA_MVR_12	256	257	648	726	605	733

Table A-2 (cont.). Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_IL_MA_MVR_13	257	258	571	686	499	678
CEMVR_IL_MA_MVR_14	258	259	567	649	457	618
CEMVR_IL_MA_MVR_15	259	260	604	592	353	399
CEMVR_IL_MA_MVR_16	260	261	666	584	405	361
CEMVR_IL_MA_MVR_17	261	262	724	670	527	473
CEMVR_IL_MA_MVR_18	262	263	972	961	626	574
CEMVR_IL_MA_MVR_19	263	264	1583	1567	1579	1460
CEMVR_IL_MA_MVR_20	264	265	1566	1561	1615	1593
CEMVR_IL_MA_MVR_21	265	266	972	976	976	953
CEMVR_IL_MA_MVR_22	266	267	951	943	957	918
CEMVR_IL_MA_MVR_23	267	268	958	943	974	910
CEMVR_IL_MA_MVR_24	268	269	955	945	1015	931
CEMVR_IL_MA_MVR_25	269	270	937	922	1016	918
CEMVR_IL_MA_MVR_26	270	271.5	742	733	902	786
CEMVR_IL_DR_MVR_1	271.5	273	731	728	919	778
CEMVR_IL_DR_MVR_2	273	274	737	730	918	786
CEMVR_IL_DR_MVR_3	274	275	765	750	915	799
CEMVR_IL_DR_MVR_4	275	276	783	769	914	802
CEMVR_IL_DR_MVR_5	276	277	1117	1079	1244	1105
CEMVR_IL_DR_MVR_6	277	278	1546	1542	1761	1643
CEMVR_IL_DR_MVR_7	278	279	2789	2828	3015	3054
CEMVR_IL_DR_MVR_8	279	280	1868	1882	1818	1802
CEMVR_IL_DR_MVR_9	280	281	1586	1600	1496	1486
CEMVR_IL_DR_MVR_10	281	282	1335	1345	1265	1207
CEMVR_IL_DR_MVR_11	282	283	1202	1228	1192	1133
CEMVR_IL_DR_MVR_12	283	284	1230	1252	1243	1162
CEMVR_IL_DR_MVR_13	284	285	1235	1249	1238	1131
CEMVR_IL_DR_MVR_14	285	286	1251	1255	1270	1164
CEMVR_IL_BR_MVR_1	286	287	1184	1181	1238	1095
CEMVR_IL_BR_MVR_2	287	288	1272	1281	1232	1160
CEMVR_IL_BR_MVR_3	288	289	1260	1266	1287	1147
CEMVR_IL_BR_MVR_4	289	290	1180	1187	1203	1064
CEMVR_IL_BR_MVR_5	290	291.1	1182	1187	1211	1053
CEMVR_IL_LP_MVR_1	291.1	292	1218	1217	1234	1088
CEMVR_IL_LP_MVR_2	292	293	1210	1206	1214	1085
CEMVR_IL_LP_MVR_3	293	294	1459	1416	1349	1189

Table A-2 (cont.). Illinois River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CEMVR_IL_LP_MVR_4	294	295	2491	2491	2447	2351
CEMVR_IL_LP_MVR_5	295	296	1567	1569	1415	1350
CEMVR_IL_LP_MVR_6	296	297	1619	1649	1417	1372
CEMVR_IL_LP_MVR_7	297	298	2347	2447	1571	1600
CEMVR_IL_LP_MVR_8	298	299	2536	2648	1990	2048
CEMVR_IL_LP_MVR_9	299	300	2995	3064	2930	2983
CEMVR_IL_LP_MVR_10	300	301	2252	2340	1939	1909
CEMVR_IL_LP_MVR_11	301	302	1241	1248	820	871
CEMVR_IL_LP_MVR_12	302	303	1237	1223	851	919
CEMVR_IL_LP_MVR_13	303	304	1520	1479	1334	1341
CEMVR_IL_LP_MVR_14	304	305	283	359	222	302
CEMVR_IL_LP_MVR_15	305	306	298	361	253	301
CEMVR_IL_LP_MVR_16	306	307	259	241	229	184
CEMVR_IL_LP_MVR_17	307	308	280	260	259	184
CEMVR_IL_LP_MVR_18	308	309	559	565	484	451
CEMVR_IL_LP_MVR_19	309	310	644	632	560	538
CEMVR_IL_LP_MVR_20	310	311	658	648	594	583
CEMVR_IL_LP_MVR_21	311	312	464	469	491	469
CEMVR_IL_LP_MVR_22	312	313	414	420	421	407
CEMVR_IL_LP_MVR_23	313	314	424	422	443	431
CEMVR_IL_LP_MVR_24	314	315	434	425	438	419
CEMVR_IL_LP_MVR_25	315	316	487	479	495	479
CEMVR_IL_LP_MVR_26	316	317	487	485	491	482
CEMVR_IL_LP_MVR_27	317	318	459	459	451	432
CEMVR_IL_LP_MVR_28	318	319	467	480	469	454
CEMVR_IL_LP_MVR_29	319	320	779	782	504	493
CEMVR_IL_LP_MVR_30	320	321	782	780	684	665
CEMVR_IL_LP_MVR_31	321	322	888	922	929	935
CEMVR_IL_LP_MVR_32	322	323	938	920	943	887
CEMVR_IL_LP_MVR_33	323	324	615	619	529	486
CEMVR_IL_LP_MVR_34	324	325.5	296	258	643	533

A.3 Ohio River Transit Counts Per Reach in 2020 and 2021

Table A-3. Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRP_OH_LP_EMS_1	0	1	2025	2028	2753	2799
CELRP_OH_LP_EMS_2	1	2	1854	1854	2137	2194
CELRP_OH_LP_EMS_3	2	3	1857	1847	2131	2128
CELRP_OH_LP_EMS_4	3	4	1740	1736	1962	1949
CELRP_OH_LP_EMS_5	4	5	2078	2062	1984	1971
CELRP_OH_LP_EMS_6	5	6	1410	1419	1392	1391
CELRP_OH_LP_DAS_1	6	7	1317	1273	1283	1303
CELRP_OH_LP_DAS_2	7	8	1385	1402	1270	1282
CELRP_OH_LP_DAS_3	8	9	1490	1500	1468	1492
CELRP_OH_LP_DAS_4	9	10	1655	1648	1616	1628
CELRP_OH_LP_DAS_5	10	11	1243	1238	1239	1259
CELRP_OH_LP_DAS_6	11	12	1286	1282	1241	1261
CELRP_OH_LP_DAS_7	12	13	1294	1280	1263	1267
CELRP_OH_LP_DAS_8	13	13.5	1308	1754	1307	3289
CELRP_OH_LP_MNT_1	13.5	14	1293	1278	1252	1280
CELRP_OH_LP_MNT_2	14	15	1530	1517	1447	1478
CELRP_OH_LP_MNT_3	15	16	1728	1723	1812	1867
CELRP_OH_LP_MNT_4	16	17	2114	2085	2254	2229
CELRP_OH_LP_MNT_5	17	18	1487	1495	1481	1487
CELRP_OH_LP_MNT_6	18	19	1474	1462	1455	1473
CELRP_OH_LP_MNT_7	19	20	1238	1243	1176	1198
CELRP_OH_LP_MNT_8	20	21	1248	1257	1205	1224
CELRP_OH_LP_MNT_9	21	22	1271	1264	1220	1237
CELRP_OH_LP_MNT_10	22	23	1248	1246	1221	1259
CELRP_OH_LP_MNT_11	23	24	1485	1464	1665	1701
CELRP_OH_LP_MNT_12	24	25	1187	1101	1202	1229
CELRP_OH_LP_MNT_13	25	26	417	425	1168	1198
CELRP_OH_LP_MNT_14	26	27	407	419	1146	1174
CELRP_OH_LP_MNT_15	27	28	465	477	1189	1206
CELRP_OH_LP_MNT_16	28	29	490	510	1195	1209
CELRP_OH_LP_MNT_17	29	30	710	739	1245	1264
CELRP_OH_LP_MNT_18	30	31	805	847	1357	1373
CELRP_OH_LP_MNT_19	31	31.5	648	647	1516	1526
CELRP_OH_LP_NC1_1	31.5	32	570	604	1661	1644
CELRP_OH_LP_NC1_2	32	33	566	600	1410	1440

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRP_OH_LP_NC1_3	33	34	689	741	1622	1642
CELRP_OH_LP_NC1_4	34	35	654	717	1536	1562
CELRP_OH_LP_NC1_5	35	36	836	896	1653	1686
CELRP_OH_LP_NC1_6	36	37	1422	1458	1804	1833
CELRP_OH_LP_NC1_7	37	38	1624	1619	1902	1921
CELRP_OH_LP_NC1_8	38	39	1285	1212	1875	1861
CELRP_OH_LP_NC1_9	39	40	1585	1441	3260	3137
CELRP_OH_LP_NC2_1	40	41	588	435	1257	869
CELRP_OH_LP_NC2_2	41	42	107	49	107	59
CELRP_OH_LP_NC2_3	42	43	20	13	16	8
CELRP_OH_LP_NC2_4	43	44	76	58	55	48
CELRP_OH_LP_NC2_5	44	45	345	319	298	236
CELRP_OH_LP_NC2_6	45	46	137	137	410	381
CELRP_OH_LP_NC2_7	46	47	84	107	497	557
CELRP_OH_LP_NC2_8	47	48	375	544	974	1081
CELRP_OH_LP_NC2_9	48	49	653	818	978	1071
CELRP_OH_LP_NC2_10	49	50	719	707	957	988
CELRP_OH_LP_NC2_11	50	51	931	985	1110	1138
CELRP_OH_LP_NC2_12	51	52	994	1018	1118	1132
CELRP_OH_LP_NC2_13	52	53	1002	1026	1112	1126
CELRP_OH_LP_NC2_14	53	54	1050	1064	1186	1203
CELRP_OH_LP_NC2_15	54	54.5	1074	1815	1233	2910
CELRP_OH_LP_PIK_1	54.5	55	1048	1044	1177	1186
CELRP_OH_LP_PIK_2	55	56	1042	1051	1165	1168
CELRP_OH_LP_PIK_3	56	57	1036	1046	1167	1172
CELRP_OH_LP_PIK_4	57	58	1032	1042	1167	1175
CELRP_OH_LP_PIK_5	58	59	1034	1044	1182	1181
CELRP_OH_LP_PIK_6	59	60	981	987	1170	1158
CELRP_OH_LP_PIK_7	60	61	738	764	1025	1006
CELRP_OH_LP_PIK_8	61	62	696	726	867	849
CELRP_OH_LP_PIK_9	62	63	691	695	830	796
CELRP_OH_LP_PIK_10	63	64	157	166	348	344
CELRP_OH_LP_PIK_11	64	65	2	0	2	1
CELRP_OH_LP_PIK_12	65	66	3	0	0	0
CELRP_OH_LP_PIK_13	66	67	0	0	0	0
CELRP_OH_LP_PIK_14	67	68	1	2	2	2

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRP_OH_LP_PIK_15	68	69	2	5	10	8
CELRP_OH_LP_PIK_16	69	70	50	61	16	51
CELRP_OH_LP_PIK_17	70	71	2139	2297	2122	2513
CELRP_OH_LP_PIK_18	71	72	1329	1370	1007	1141
CELRP_OH_LP_PIK_19	72	73	854	775	361	369
CELRP_OH_LP_PIK_20	73	74	848	779	372	367
CELRP_OH_LP_PIK_21	74	75	1402	1499	1280	1372
CELRP_OH_LP_PIK_22	75	76	2112	2155	1978	2041
CELRP_OH_LP_PIK_23	76	77	2614	2705	2556	2637
CELRP_OH_LP_PIK_24	77	78	1744	1743	1734	1731
CELRP_OH_LP_PIK_25	78	79	1755	1763	1774	1769
CELRP_OH_LP_PIK_26	79	80	1757	1763	1764	1761
CELRP_OH_LP_PIK_27	80	81	1758	1764	1775	1772
CELRP_OH_LP_PIK_28	81	82	1838	1839	2019	2028
CELRP_OH_LP_PIK_29	82	83	2341	2305	2270	2264
CELRP_OH_LP_PIK_30	83	84.5	1587	1589	1572	1562
CELRP_OH_LP_HAN_1	84.5	85	1587	1576	1560	1537
CELRP_OH_LP_HAN_2	85	86	1575	1580	1531	1536
CELRP_OH_LP_HAN_3	86	87	1577	1587	1519	1535
CELRP_OH_LP_HAN_4	87	88	1571	1588	1512	1528
CELRP_OH_LP_HAN_5	88	89	1562	1590	1505	1532
CELRP_OH_LP_HAN_6	89	90	1574	1589	1513	1532
CELRP_OH_LP_HAN_7	90	91	1586	1587	1519	1518
CELRP_OH_LP_HAN_8	91	92	1602	1589	1531	1552
CELRP_OH_LP_HAN_9	92	93	4734	4709	4029	4054
CELRP_OH_LP_HAN_10	93	94	4026	4016	3288	3358
CELRP_OH_LP_HAN_11	94	95	2979	2972	2367	2379
CELRP_OH_LP_HAN_12	95	96	1750	1765	1483	1495
CELRP_OH_LP_HAN_13	96	97	1461	1499	872	815
CELRP_OH_LP_HAN_14	97	98	1458	1500	855	798
CELRP_OH_LP_HAN_15	98	99	850	878	277	255
CELRP_OH_LP_HAN_16	99	100	803	780	254	225
CELRP_OH_LP_HAN_17	100	101	709	848	246	291
CELRP_OH_LP_HAN_18	101	102	313	357	95	103
CELRP_OH_LP_HAN_19	102	103	5	7	0	1
CELRP_OH_LP_HAN_20	103	104	0	0	0	0

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRP_OH_LP_HAN_21	104	105	0	0	0	0
CELRP_OH_LP_HAN_22	105	106	0	0	0	0
CELRP_OH_LP_HAN_23	106	107	0	0	0	0
CELRP_OH_LP_HAN_24	107	108	0	0	0	0
CELRP_OH_LP_HAN_25	108	109	0	0	0	0
CELRP_OH_LP_HAN_26	109	110	0	0	0	0
CELRP_OH_LP_HAN_27	110	111	2	2	2	4
CELRP_OH_LP_HAN_28	111	112	2	1	1	1
CELRP_OH_LP_HAN_29	112	113	0	0	1	0
CELRP_OH_LP_HAN_30	113	114	0	0	0	0
CELRP_OH_LP_HAN_31	114	115	0	0	0	0
CELRP_OH_LP_HAN_32	115	116	0	0	0	0
CELRP_OH_LP_HAN_33	116	117	5	4	3	7
CELRP_OH_LP_HAN_34	117	118	516	582	592	666
CELRP_OH_LP_HAN_35	118	119	437	563	526	635
CELRP_OH_LP_HAN_36	119	120	855	988	907	1072
CELRP_OH_LP_HAN_37	120	121	1761	1755	1844	1875
CELRP_OH_LP_HAN_38	121	122	1865	1875	2006	1993
CELRP_OH_LP_HAN_39	122	123	1906	1938	2010	1998
CELRP_OH_LP_HAN_40	123	124	2566	2630	2479	2518
CELRP_OH_LP_HAN_41	124	125	1781	1796	1778	1769
CELRP_OH_LP_HAN_42	125	126	1806	1786	1773	1760
CELRP_OH_LP_HAN_43	126	127	1752	1768	1710	1715
CELRH_OH_HD_WIO_36	127	128	1684	1710	1683	1709
CELRH_OH_HD_WIO_35	128	129	1694	1704	1680	1699
CELRH_OH_HD_WIO_34	129	130	1585	1585	1573	1583
CELRH_OH_HD_WIO_33	130	131	1565	1560	1571	1577
CELRH_OH_HD_WIO_32	131	132	1547	1535	1578	1572
CELRH_OH_HD_WIO_31	132	133	1353	1349	1373	1360
CELRH_OH_HD_WIO_30	133	134	1	0	479	470
CELRH_OH_HD_WIO_29	134	135	0	0	378	366
CELRH_OH_HD_WIO_28	135	136	2	11	262	270
CELRH_OH_HD_WIO_27	136	137	362	296	330	300
CELRH_OH_HD_WIO_26	137	138	174	129	223	109
CELRH_OH_HD_WIO_25	138	139	81	74	136	58
CELRH_OH_HD_WIO_24	139	140	25	33	50	38

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_WIO_23	140	141	15	14	37	39
CELRH_OH_HD_WIO_22	141	142	1	3	9	9
CELRH_OH_HD_WIO_21	142	143	0	0	1	2
CELRH_OH_HD_WIO_20	143	144	0	0	1	0
CELRH_OH_HD_WIO_19	144	145	0	0	0	1
CELRH_OH_HD_WIO_18	145	146	0	0	1	1
CELRH_OH_HD_WIO_17	146	147	0	0	66	117
CELRH_OH_HD_WIO_16	147	148	0	0	641	710
CELRH_OH_HD_WIO_15	148	149	0	0	768	827
CELRH_OH_HD_WIO_14	149	150	0	0	757	839
CELRH_OH_HD_WIO_13	150	151	0	0	969	989
CELRH_OH_HD_WIO_12	151	152	0	0	959	988
CELRH_OH_HD_WIO_11	152	153	0	0	773	807
CELRH_OH_HD_WIO_10	153	154	0	0	791	812
CELRH_OH_HD_WIO_9	154	155	0	0	962	999
CELRH_OH_HD_WIO_8	155	156	0	0	977	1005
CELRH_OH_HD_WIO_7	156	157	0	0	1014	1037
CELRH_OH_HD_WIO_6	157	158	312	486	1024	1055
CELRH_OH_HD_WIO_5	158	159	1183	1360	1049	1082
CELRH_OH_HD_WIO_4	159	160	1405	1438	1030	1065
CELRH_OH_HD_WIO_3	160	161	1915	1892	1377	1387
CELRH_OH_HD_WIO_2	161	161.7	1839	1816	1339	1351
CELRH_OH_HD_WIO_1	161.7	163	1817	1795	1319	1304
CELRH_OH_HD_BEL_42	163	164	1803	1776	1172	1170
CELRH_OH_HD_BEL_41	164	165	1382	1314	1127	1136
CELRH_OH_HD_BEL_40	165	166	66	61	1091	1104
CELRH_OH_HD_BEL_39	166	167	0	0	1074	1080
CELRH_OH_HD_BEL_38	167	168	0	0	1103	1126
CELRH_OH_HD_BEL_37	168	169	0	0	995	1022
CELRH_OH_HD_BEL_36	169	170	0	0	752	783
CELRH_OH_HD_BEL_35	170	171	0	0	543	556
CELRH_OH_HD_BEL_34	171	172	0	0	513	517
CELRH_OH_HD_BEL_33	172	173	1	4	82	115
CELRH_OH_HD_BEL_32	173	174	4	7	74	134
CELRH_OH_HD_BEL_31	174	175	4	5	37	69
CELRH_OH_HD_BEL_30	175	176	4	2	12	26

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_BEL_29	176	177	0	1	10	25
CELRH_OH_HD_BEL_28	177	178	1	3	109	141
CELRH_OH_HD_BEL_27	178	179	4	5	465	626
CELRH_OH_HD_BEL_26	179	180	0	2	107	316
CELRH_OH_HD_BEL_25	180	181	1	2	156	286
CELRH_OH_HD_BEL_24	181	182	1	3	66	118
CELRH_OH_HD_BEL_23	182	183	2	3	68	106
CELRH_OH_HD_BEL_22	183	184	1	3	198	212
CELRH_OH_HD_BEL_21	184	185	0	0	75	88
CELRH_OH_HD_BEL_20	185	186	0	0	79	88
CELRH_OH_HD_BEL_19	186	187	0	0	140	133
CELRH_OH_HD_BEL_18	187	188	0	0	145	170
CELRH_OH_HD_BEL_17	188	189	0	0	258	272
CELRH_OH_HD_BEL_16	189	190	0	1	1091	1203
CELRH_OH_HD_BEL_15	190	191	6	5	1402	1427
CELRH_OH_HD_BEL_14	191	192	2	4	1396	1410
CELRH_OH_HD_BEL_13	192	193	0	1	1374	1383
CELRH_OH_HD_BEL_12	193	194	2	1	1387	1381
CELRH_OH_HD_BEL_11	194	195	1	0	1344	1358
CELRH_OH_HD_BEL_10	195	196	1	0	1336	1364
CELRH_OH_HD_BEL_9	196	197	4	9	1339	1356
CELRH_OH_HD_BEL_8	197	198	66	113	1352	1368
CELRH_OH_HD_BEL_7	198	199	161	202	1359	1383
CELRH_OH_HD_BEL_6	199	200	901	1036	1382	1414
CELRH_OH_HD_BEL_5	200	201	1293	1321	1403	1421
CELRH_OH_HD_BEL_4	201	202	1400	1393	1419	1446
CELRH_OH_HD_BEL_3	202	203	1411	1378	1442	1453
CELRH_OH_HD_BEL_2	203	204	1524	1419	1468	1478
CELRH_OH_HD_BEL_1	204	205	1494	1454	1452	1462
CELRH_OH_HD_RAO_34	205	206	1339	1418	1430	1464
CELRH_OH_HD_RAO_33	206	207	1324	1417	1439	1475
CELRH_OH_HD_RAO_32	207	208	1304	1318	1423	1448
CELRH_OH_HD_RAO_31	208	209	726	725	1405	1423
CELRH_OH_HD_RAO_30	209	210	54	58	1375	1409
CELRH_OH_HD_RAO_29	210	211	0	0	1365	1380
CELRH_OH_HD_RAO_28	211	212	0	0	1353	1383

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_RAO_27	212	213	0	0	1357	1385
CELRH_OH_HD_RAO_26	213	214	30	55	1361	1377
CELRH_OH_HD_RAO_25	214	215	0	7	1352	1377
CELRH_OH_HD_RAO_24	215	216	2	10	1291	1327
CELRH_OH_HD_RAO_23	216	217	11	22	1314	1348
CELRH_OH_HD_RAO_22	217	218	13	20	1304	1351
CELRH_OH_HD_RAO_21	218	219	9	12	1305	1360
CELRH_OH_HD_RAO_20	219	220	2	3	1273	1278
CELRH_OH_HD_RAO_19	220	221	2	3	535	388
CELRH_OH_HD_RAO_18	221	222	5	5	409	336
CELRH_OH_HD_RAO_17	222	223	2	0	925	926
CELRH_OH_HD_RAO_16	223	224	2	0	762	754
CELRH_OH_HD_RAO_15	224	225	2	1	821	863
CELRH_OH_HD_RAO_14	225	226	1	2	1136	1233
CELRH_OH_HD_RAO_13	226	227	10	16	1145	1234
CELRH_OH_HD_RAO_12	227	228	2	11	1163	1249
CELRH_OH_HD_RAO_11	228	229	1	3	1305	1342
CELRH_OH_HD_RAO_10	229	230	2	6	1459	1531
CELRH_OH_HD_RAO_9	230	231	55	70	1512	1515
CELRH_OH_HD_RAO_8	231	232	292	263	1228	1212
CELRH_OH_HD_RAO_7	232	233	319	319	1182	1174
CELRH_OH_HD_RAO_6	233	234	1130	1222	1318	1360
CELRH_OH_HD_RAO_5	234	235	1370	1350	1500	1571
CELRH_OH_HD_RAO_4	235	236	1457	1429	1593	1647
CELRH_OH_HD_RAO_3	236	237	1497	1473	1604	1677
CELRH_OH_HD_RAO_2	237	237.6	1616	1583	1642	1685
CELRH_OH_HD_RAO_1	237.6	238	1648	1686	1638	1679
CELRH_OH_HD_RCB_42	238	239	1465	1513	1613	1637
CELRH_OH_HD_RCB_41	239	240	1443	1469	1602	1638
CELRH_OH_HD_RCB_40	240	241	1405	1440	1540	1570
CELRH_OH_HD_RCB_39	241	242	910	856	1208	1213
CELRH_OH_HD_RCB_38	242	243	369	415	1119	1139
CELRH_OH_HD_RCB_37	243	244	17	9	1061	1094
CELRH_OH_HD_RCB_36	244	245	8	3	862	847
CELRH_OH_HD_RCB_35	245	246	0	0	728	735
CELRH_OH_HD_RCB_34	246	247	0	0	638	662

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_RCB_33	247	248	6	8	633	653
CELRH_OH_HD_RCB_32	248	249	16	20	212	201
CELRH_OH_HD_RCB_31	249	250	24	25	48	55
CELRH_OH_HD_RCB_30	250	251	67	71	38	83
CELRH_OH_HD_RCB_29	251	252	79	90	54	99
CELRH_OH_HD_RCB_28	252	253	53	46	37	68
CELRH_OH_HD_RCB_27	253	254	35	25	22	44
CELRH_OH_HD_RCB_26	254	255	56	48	32	58
CELRH_OH_HD_RCB_25	255	256	675	713	498	662
CELRH_OH_HD_RCB_24	256	257	714	852	526	718
CELRH_OH_HD_RCB_23	257	258	1060	1202	843	1067
CELRH_OH_HD_RCB_22	258	259	3024	3006	2899	2921
CELRH_OH_HD_RCB_21	259	260	1936	2145	1847	1997
CELRH_OH_HD_RCB_20	260	261	1833	1835	1737	1760
CELRH_OH_HD_RCB_19	261	262	1684	1707	1541	1623
CELRH_OH_HD_RCB_18	262	263	1675	1703	1533	1630
CELRH_OH_HD_RCB_17	263	264	2006	2003	1952	1990
CELRH_OH_HD_RCB_16	264	265	2032	2049	1928	1979
CELRH_OH_HD_RCB_15	265	266	3421	3578	3735	3946
CELRH_OH_HD_RCB_14	266	267	3930	3929	3150	3133
CELRH_OH_HD_RCB_13	267	268	2020	2068	1905	1936
CELRH_OH_HD_RCB_12	268	269	1601	1671	1521	1638
CELRH_OH_HD_RCB_11	269	270	1684	1697	1626	1672
CELRH_OH_HD_RCB_10	270	271	1641	1643	1612	1638
CELRH_OH_HD_RCB_9	271	272	1638	1633	1609	1634
CELRH_OH_HD_RCB_8	272	273	1616	1605	1585	1609
CELRH_OH_HD_RCB_7	273	274	1612	1605	1580	1612
CELRH_OH_HD_RCB_6	274	275	1641	1617	1590	1620
CELRH_OH_HD_RCB_5	275	276	1646	1633	1585	1621
CELRH_OH_HD_RCB_4	276	277	1680	1671	1625	1643
CELRH_OH_HD_RCB_3	277	278	1708	1709	1622	1678
CELRH_OH_HD_RCB_2	278	279	1705	1703	1639	1664
CELRH_OH_HD_RCB_1	279	280	1642	1644	1597	1629
CELRH_OH_HD_GRO_62	280	281	1605	1608	1587	1616
CELRH_OH_HD_GRO_61	281	282	1513	1508	1476	1489
CELRH_OH_HD_GRO_60	282	283	1523	1520	1490	1505

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_GRO_59	283	284	1572	1616	1516	1573
CELRH_OH_HD_GRO_58	284	285	1633	1644	1564	1597
CELRH_OH_HD_GRO_57	285	286	1593	1632	1523	1575
CELRH_OH_HD_GRO_56	286	287	1558	1609	1499	1560
CELRH_OH_HD_GRO_55	287	288	1533	1576	1418	1485
CELRH_OH_HD_GRO_54	288	289	1521	1560	1282	1364
CELRH_OH_HD_GRO_53	289	290	1561	1588	1266	1345
CELRH_OH_HD_GRO_52	290	291	1625	1640	1350	1415
CELRH_OH_HD_GRO_51	291	292	1626	1640	1402	1452
CELRH_OH_HD_GRO_50	292	293	1616	1626	1370	1404
CELRH_OH_HD_GRO_49	293	294	1619	1627	1334	1366
CELRH_OH_HD_GRO_48	294	295	1638	1635	1375	1393
CELRH_OH_HD_GRO_47	295	296	1642	1639	1369	1391
CELRH_OH_HD_GRO_46	296	297	1640	1639	1371	1391
CELRH_OH_HD_GRO_45	297	298	1645	1642	1379	1404
CELRH_OH_HD_GRO_44	298	299	1646	1642	1371	1407
CELRH_OH_HD_GRO_43	299	300	1663	1666	1413	1450
CELRH_OH_HD_GRO_42	300	301	1674	1673	1416	1460
CELRH_OH_HD_GRO_41	301	302	1664	1670	1407	1466
CELRH_OH_HD_GRO_40	302	303	1648	1671	1391	1448
CELRH_OH_HD_GRO_39	303	304	1641	1670	1383	1442
CELRH_OH_HD_GRO_38	304	305	1659	1684	1455	1484
CELRH_OH_HD_GRO_37	305	306	1671	1687	1459	1502
CELRH_OH_HD_GRO_36	306	307	1666	1685	1473	1518
CELRH_OH_HD_GRO_35	307	308	1661	1687	1470	1512
CELRH_OH_HD_GRO_34	308	309	1711	1745	1495	1539
CELRH_OH_HD_GRO_33	309	310	1710	1743	1497	1535
CELRH_OH_HD_GRO_32	310	311	1730	1744	1504	1539
CELRH_OH_HD_GRO_31	311	312	2056	2093	1564	1595
CELRH_OH_HD_GRO_30	312	313	2155	2213	1590	1655
CELRH_OH_HD_GRO_29	313	314	2145	2214	1580	1643
CELRH_OH_HD_GRO_28	314	315	3146	3133	2478	2524
CELRH_OH_HD_GRO_27	315	316	5025	5191	4297	4414
CELRH_OH_HD_GRO_26	316	317	9026	13344	7366	10568
CELRH_OH_HD_GRO_25	317	318	8582	12463	6902	10251
CELRH_OH_HD_GRO_24	318	319	7532	7510	6231	6128

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_GRO_23	319	320	4531	4486	3731	3716
CELRH_OH_HD_GRO_22	320	321	3497	3444	2950	2950
CELRH_OH_HD_GRO_21	321	322	2366	2422	2108	2172
CELRH_OH_HD_GRO_20	322	323	2218	2294	1919	1969
CELRH_OH_HD_GRO_19	323	324	2171	2220	1881	1913
CELRH_OH_HD_GRO_18	324	325	2165	2200	1874	1897
CELRH_OH_HD_GRO_17	325	326	2122	2144	1818	1832
CELRH_OH_HD_GRO_16	326	327	2136	2138	1816	1851
CELRH_OH_HD_GRO_15	327	328	2122	2138	1791	1851
CELRH_OH_HD_GRO_14	328	329	2108	2134	1784	1829
CELRH_OH_HD_GRO_13	329	330	2078	2131	1792	1844
CELRH_OH_HD_GRO_12	330	331	2055	2136	1768	1842
CELRH_OH_HD_GRO_11	331	332	2070	2139	1792	1917
CELRH_OH_HD_GRO_10	332	333	2136	2176	2113	2207
CELRH_OH_HD_GRO_9	333	334	2156	2198	2216	2268
CELRH_OH_HD_GRO_8	334	335	2188	2263	2277	2299
CELRH_OH_HD_GRO_7	335	336	2195	2265	2283	2297
CELRH_OH_HD_GRO_6	336	337	1954	1974	1938	1964
CELRH_OH_HD_GRO_5	337	338	1968	1977	1967	1974
CELRH_OH_HD_GRO_4	338	339	1971	1977	1978	1979
CELRH_OH_HD_GRO_3	339	340	1985	1983	1969	1963
CELRH_OH_HD_GRO_2	340	341	1994	1993	1977	1985
CELRH_OH_HD_GRO_1	341	342	1861	1859	1899	1905
CELRH_OH_HD_CAM_96	342	343	1833	1829	1812	1829
CELRH_OH_HD_CAM_95	343	344	1847	1842	1826	1832
CELRH_OH_HD_CAM_94	344	345	1807	1811	1781	1798
CELRH_OH_HD_CAM_93	345	346	2247	2259	1759	1781
CELRH_OH_HD_CAM_92	346	347	2244	2238	1767	1758
CELRH_OH_HD_CAM_91	347	348	1876	1897	1755	1757
CELRH_OH_HD_CAM_90	348	349	1876	1908	1762	1764
CELRH_OH_HD_CAM_89	349	350	1866	1881	1724	1763
CELRH_OH_HD_CAM_88	350	351	1673	1704	1548	1606
CELRH_OH_HD_CAM_87	351	352	1242	1132	996	863
CELRH_OH_HD_CAM_86	352	353	1038	1038	787	768
CELRH_OH_HD_CAM_85	353	354	975	1189	810	1064
CELRH_OH_HD_CAM_84	354	355	530	546	408	414

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_CAM_83	355	356	235	203	144	149
CELRH_OH_HD_CAM_82	356	357	297	279	222	212
CELRH_OH_HD_CAM_81	357	358	699	786	555	620
CELRH_OH_HD_CAM_80	358	359	310	311	251	228
CELRH_OH_HD_CAM_79	359	360	42	92	33	60
CELRH_OH_HD_CAM_78	360	361	27	62	24	46
CELRH_OH_HD_CAM_77	361	362	33	65	33	43
CELRH_OH_HD_CAM_76	362	363	190	268	153	179
CELRH_OH_HD_CAM_75	363	364	182	186	123	135
CELRH_OH_HD_CAM_74	364	365	199	181	153	119
CELRH_OH_HD_CAM_72	365	367	14	20	16	17
CELRH_OH_HD_CAM_73	365	366	44	30	36	27
CELRH_OH_HD_CAM_71	367	368	10	34	20	26
CELRH_OH_HD_CAM_70	368	369	28	48	29	31
CELRH_OH_HD_CAM_69	369	370	300	262	211	172
CELRH_OH_HD_CAM_68	370	371	356	321	246	197
CELRH_OH_HD_CAM_67	371	372	530	472	405	316
CELRH_OH_HD_CAM_66	372	373	601	529	471	362
CELRH_OH_HD_CAM_65	373	374	42	53	43	36
CELRH_OH_HD_CAM_64	374	375	28	35	26	22
CELRH_OH_HD_CAM_63	375	376	10	11	12	10
CELRH_OH_HD_CAM_62	376	377	5	6	8	5
CELRH_OH_HD_CAM_61	377	378	9	6	10	11
CELRH_OH_HD_CAM_60	378	379	8	8	11	7
CELRH_OH_HD_CAM_59	379	380	19	18	17	17
CELRH_OH_HD_CAM_58	380	381	22	31	23	26
CELRH_OH_HD_CAM_57	381	382	5	13	8	15
CELRH_OH_HD_CAM_56	382	383	4	9	5	16
CELRH_OH_HD_CAM_55	383	384	15	17	15	15
CELRH_OH_HD_CAM_54	384	385	61	63	54	39
CELRH_OH_HD_CAM_53	385	386	107	96	93	65
CELRH_OH_HD_CAM_52	386	387	87	53	67	39
CELRH_OH_HD_CAM_51	387	388	67	39	48	31
CELRH_OH_HD_CAM_50	388	389	63	56	60	47
CELRH_OH_HD_CAM_49	389	390	18	23	32	20
CELRH_OH_HD_CAM_48	390	391	14	20	24	17

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_CAM_47	391	392	49	41	70	46
CELRH_OH_HD_CAM_46	392	393	27	20	38	20
CELRH_OH_HD_CAM_45	393	394	7	8	19	6
CELRH_OH_HD_CAM_44	394	395	0	1	7	3
CELRH_OH_HD_CAM_43	395	396	0	1	0	3
CELRH_OH_HD_CAM_42	396	397	0	0	0	2
CELRH_OH_HD_CAM_41	397	398	0	1	1	1
CELRH_OH_HD_CAM_40	398	399	0	1	1	2
CELRH_OH_HD_CAM_39	399	400	1	1	1	2
CELRH_OH_HD_CAM_38	400	401	1	0	0	1
CELRH_OH_HD_CAM_37	401	402	2	0	0	0
CELRH_OH_HD_CAM_36	402	403	4	1	7	8
CELRH_OH_HD_CAM_35	403	404	40	58	102	115
CELRH_OH_HD_CAM_34	404	405	41	59	98	154
CELRH_OH_HD_CAM_33	405	406	12	11	18	19
CELRH_OH_HD_CAM_32	406	407	10	5	8	8
CELRH_OH_HD_CAM_31	407	408	5	10	5	9
CELRH_OH_HD_CAM_30	408	409	7	5	11	7
CELRH_OH_HD_CAM_29	409	410	2	1	3	1
CELRH_OH_HD_CAM_28	410	411	1	2	2	1
CELRH_OH_HD_CAM_27	411	412	4	5	6	8
CELRH_OH_HD_CAM_26	412	413	59	91	83	133
CELRH_OH_HD_CAM_25	413	414	65	157	106	190
CELRH_OH_HD_CAM_24	414	415	8	3	9	15
CELRH_OH_HD_CAM_23	415	416	3	3	3	5
CELRH_OH_HD_CAM_22	416	417	3	3	3	5
CELRH_OH_HD_CAM_21	417	418	52	71	66	74
CELRH_OH_HD_CAM_20	418	419	325	365	416	428
CELRH_OH_HD_CAM_19	419	420	807	851	899	990
CELRH_OH_HD_CAM_18	420	421	838	728	928	893
CELRH_OH_HD_CAM_17	421	422	349	331	405	313
CELRH_OH_HD_CAM_16	422	423	293	320	337	313
CELRH_OH_HD_CAM_15	423	424	730	1028	865	1186
CELRH_OH_HD_CAM_14	424	425	1412	1412	1551	1605
CELRH_OH_HD_CAM_13	425	426	1413	1443	1564	1612
CELRH_OH_HD_CAM_12	426	427	1439	1462	1587	1623

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRH_OH_HD_CAM_11	427	428	1465	1467	1601	1625
CELRH_OH_HD_CAM_10	428	429	1465	1478	1621	1645
CELRH_OH_HD_CAM_9	429	430	1464	1470	1606	1637
CELRH_OH_HD_CAM_8	430	431	1469	1473	1615	1650
CELRH_OH_HD_CAM_7	431	432	1476	1476	1624	1650
CELRH_OH_HD_CAM_6	432	433	1483	1484	1621	1656
CELRH_OH_HD_CAM_5	433	434	1492	1538	1613	1673
CELRH_OH_HD_CAM_4	434	435	1508	1541	1636	1677
CELRH_OH_HD_CAM_3	435	436.2	1537	1569	1675	1704
CELRH_OH_HD_CAM_2	436.2	437	1543	1534	1656	1682
CELRH_OH_HD_CAM_1	437	438	1548	1561	1659	1700
CELRL_OH_LD_MKL_7	438	451	1563	1587	1579	1580
CELRL_OH_LD_MKL_6	451	460	1700	1704	1585	1598
CELRL_OH_LD_MKL_5	460	472	1949	1979	1806	1841
CELRL_OH_LD_MKL_4	472	490	858	981	801	883
CELRL_OH_LD_MKL_3	490	510	171	173	151	124
CELRL_OH_LD_MKL_2	510	530	204	195	202	184
CELRL_OH_LD_MKL_1	530	534	1459	1516	1443	1532
CELRL_OH_LD_MCA_7	534	540	1494	1525	1469	1491
CELRL_OH_LD_MCA_6	540	544	1621	1686	1524	1569
CELRL_OH_LD_MCA_5	544	556	11	8	9	12
CELRL_OH_LD_MCA_4	556	565	1	1	0	3
CELRL_OH_LD_MCA_3	565	584	4	5	3	9
CELRL_OH_LD_MCA_2	584	604	1541	1611	1467	1587
CELRL_OH_LD_MCA_1	604	611	2120	2049	1958	1951
CELRL_OH_LD_CAN_8	611	625	1793	1812	1690	1744
CELRL_OH_LD_CAN_7	625	639	56	43	144	116
CELRL_OH_LD_CAN_6	639	659	0	0	0	1
CELRL_OH_LD_CAN_5	659	664	0	0	0	0
CELRL_OH_LD_CAN_4	664	680	0	0	0	0
CELRL_OH_LD_CAN_3	680	700	0	0	6	1
CELRL_OH_LD_CAN_2	700	720	1566	1590	1269	1333
CELRL_OH_LD_CAN_1	720	723	1802	1827	1545	1571
CELRL_OH_LD_NBG_12	723	727	749	703	535	505
CELRL_OH_LD_NBG_11	727	731	47	24	22	24
CELRL_OH_LD_NBG_10	731	733	2	0	2	2

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRL_OH_LD_NBG_9	733	738.5	6	5	2	5
CELRL_OH_LD_NBG_8	738.5	741.2	20	29	17	46
CELRL_OH_LD_NBG_7	741.2	745	28	88	18	62
CELRL_OH_LD_NBG_6	745	749	88	166	34	71
CELRL_OH_LD_NBG_5	749	754	209	339	162	219
CELRL_OH_LD_NBG_4	754	764	1000	1141	673	758
CELRL_OH_LD_NBG_3	764	770	2013	2070	2037	2122
CELRL_OH_LD_NBG_2	770	775	2048	2064	2177	2200
CELRL_OH_LD_NBG_1	775	779	2138	2160	2273	2299
CELRL_OH_LD_JTM_14	779	781	2261	2304	2743	2796
CELRL_OH_LD_JTM_13	781	785	2142	2315	2289	2440
CELRL_OH_LD_JTM_12	785	790	2161	2192	2261	2357
CELRL_OH_LD_JTM_11	790	793	2256	2272	2338	2387
CELRL_OH_LD_JTM_10	793	800	1675	1848	1638	1876
CELRL_OH_LD_JTM_9	800	805	1145	1244	1085	1222
CELRL_OH_LD_JTM_8	805	812.3	1019	1104	1012	1103
CELRL_OH_LD_JTM_7	812.3	817	1473	1650	1433	1676
CELRL_OH_LD_JTM_6	817	823	1277	1391	1581	1715
CELRL_OH_LD_JTM_5	823	827.1	818	788	1698	1739
CELRL_OH_LD_JTM_4	827.1	831	658	559	1663	1685
CELRL_OH_LD_JTM_3	831	836.5	26	28	1692	1672
CELRL_OH_LD_JTM_2	836.5	843.5	6	10	1465	1458
CELRL_OH_LD_JTM_1	843.5	847.1	2	3	1396	1380
CELRL_OH_LD_SMT_15	847.1	849.7	0	0	1416	1368
CELRL_OH_LD_SMT_14	849.7	852	4	4	1404	1402
CELRL_OH_LD_SMT_13	852	858	4	3	1345	1387
CELRL_OH_LD_SMT_12	858	862	2	5	1340	1392
CELRL_OH_LD_SMT_11	862	865	4	2	526	611
CELRL_OH_LD_SMT_10	865	868.6	0	1	2	1
CELRL_OH_LD_SMT_9	868.6	872.8	0	0	1	0
CELRL_OH_LD_SMT_8	872.8	877.1	0	0	1	1
CELRL_OH_LD_SMT_7	877.1	884	0	0	1	2
CELRL_OH_LD_SMT_6	884	891	3	0	320	341
CELRL_OH_LD_SMT_5	891	898	0	0	834	858
CELRL_OH_LD_SMT_4	898	903	0	0	1072	1094
CELRL_OH_LD_SMT_3	903	911	11	13	1151	1141

Table A-3 (cont.). Ohio River transit counts per reach, 2020 and 2021.

Channel Reach ID	Mileage Start Upstream End	Mileage End Downstream End	2020 Downbound Transit Count	2020 Upbound Transit Count	2021 Downbound Transit Count	2021 Upbound Transit Count
CELRL_OH_LD_SMT_2	911	916	1493	1496	1829	1827
CELRL_OH_LD_SMT_1	916	921	1743	1793	1939	1968
CELRL_OH_LD_OLM_12	921	924	2187	2032	2316	2134
CELRL_OH_LD_OLM_11	924	927.1	2260	2203	2889	2929
CELRL_OH_LD_OLM_10	927.1	931	1667	1605	2871	2849
CELRL_OH_LD_OLM_9	931	934	1879	1918	3624	3461
CELRL_OH_LD_OLM_8	934	938	1096	1058	3368	3264
CELRL_OH_LD_OLM_7	938	942.8	743	717	3200	3217
CELRL_OH_LD_OLM_6	942.8	946	882	872	3244	3156
CELRL_OH_LD_OLM_5	946	951	1146	1247	2500	2534
CELRL_OH_LD_OLM_4	951	954	2376	2493	2594	2732
CELRL_OH_LD_OLM_3	954	957.6	2852	2852	2757	2752
CELRL_OH_LD_OLM_2	957.6	961	3163	3058	3224	3178
CELRL_OH_LD_OLM_1	961	966.5	3071	2997	3019	3027
CELRL_OH_LD_CAI_4	966.5	970.9	3160	3019	3154	3098
CELRL_OH_LD_CAI_3	970.9	976	3141	2985	3116	3028
CELRL_OH_LD_CAI_2	976	979.5	4934	4697	4474	4335
CELRL_OH_LD_CAI_1	979.5	981	7921	7736	7065	6981

Abbreviations

AIS	Automatic Identification System
CY	Calendar year
ERDC	US Army Engineer Research and Development Center
FCC	Federal Communication Commission
ITU	International Telecommunication Union
LMR	Lower Mississippi River
LOMA	Lock Operations Management Application
MMSI	Maritime Mobile Service Identity
NCF	National Channel Framework
OTTA	Online Travel Time Atlas
RM	River mile
UMR	Upper Mississippi River
USACE	US Army Corps of Engineers
USCG	US Coast Guard
VHF	Very high frequency

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14. ABSTRACT The Automatic Identification System (AIS) shares vessel position information for navigational safety purposes. AIS broadcasts are received by other ships and terrestrial stations; however, in some areas there is no, or low, terrestrial station coverage to receive broadcasts. The US Army Corps of Engineers (USACE) developed an Online Travel Time Atlas (OTTA) to process AIS data and derive a transit count. This study examined OTTA output from 2020 and 2021 to identify areas of high or low AIS coverage along the Upper Mississippi, Illinois, and Ohio Rivers. Segments with a yearly average of two or more transit per day were classified as high coverage, those with less than a yearly average of two transits per day were classified as low coverage. Rivers were segmented using the USACE National Channel Framework reach boundaries. Results based on calculated vessel transits were as follows: Upper Mississippi River: 837.4 miles (98%) had high coverage, with 17.4 miles (2%) of low coverage; Illinois River: 190.5 miles (59%) had high AIS coverage, and 133 miles (41%) had low AIS coverage; Ohio River: 644 miles (66%) had high coverage, and 337 miles (34%) had low coverage. AIS coverage could be improved by raising antennae heights, installing repeater equipment, or adding towers.			
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