Loxahatchee River Railroad Bridge Boat Count Project

Project Summary

Introduction

The Jupiter Inlet District Board of Commissioners seeks to better understand the level of boating traffic at and around the Loxahatchee River Railroad Bridge. The impetus for this derives from a plan by All Aboard Florida – Operations LLC (AAF) to develop passenger rail traffic between south Florida and Orlando. Impacts from this project include a projected additional 32 trains (made up of both northbound and southbound trains) crossing the Loxahatchee River. These trips will result in additional bridge closings and subsequent impacts to navigation. The Loxahatchee River Railroad Bridge Boat Count Project (Project) seeks to accurately count the number of boats passing through the bridge during daylight hours. The project is also collecting ancillary data associated with bridge operations.

Equipment

The Project involves collecting and analyzing time lapse video of the Loxahatchee River Railroad Bridge openings during daylight hours over a one year period. The centerpiece of the video system is a *Brinno TLC 200 TimeLapse HD Video Camera* (Figure 1). The relatively inexpensive camera is powered by 4 standard AA batteries and records data directly to removable SD format memory cards (32 GB max). Table 1 displays customized settings applied throughout the Project after some minor experimentation early in the process. The capture rate defines how frequently the camera records a frame of video – in this case every 20 seconds. The capture rate was first estimated based on the camera positions and expected vessel speed through the field of view. Trial and error during the initial deployment confirmed that 20 seconds is the appropriate value. The camera automatically stitches sequential images together to produce an AVI format video file. All data are

Figure 1. Brinno TLC 200 TimeLapse HD Video Camera inside ATH110 Weather Resistant Housing

Table 1. Standard Camera Settings

Parameter	Setting
Capture Rate	20 seconds
AVI Frame Rate	5 fps
Band Filter	None
LED Display	On
Output Resolution	1280x720 pixels
Time & Date Set	On
Low Light	Off
Time Stamp	On
Image Quality	Best
Firmware	V 1.00.0 and V 1.02.3

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stored on the 32 GB SD card. The combination of capture rate, 4 AA batteries, and 32 GB of storage yield an average deployment of approximately 32 days.

Each camera was protected by a double layer of weather resistant housing. The first layer involved placing the camera inside an *ATH110 Weather Resistant Housing* (Figure 1). Next, the Project team developed a custom housing made from standard 4" PVC fittings to provide additional protection from the elements and to facilitate mounting (Figure 2). The combined weather protection has provided excellent results to date.

Figure 2. Custom 4" PVC housing

At the suggestion of the JID board, the Project includes 2 camera deployments in case of equipment failure. The cameras are installed on JID's channel markers #1 and #2 immediately west of the bridge location (Figure 3). Each PVC housing is secured to the channel marker piles via two hose camps (Figure 4). The external housings have been painted to blend with the piles in an effort to deter vandalism.

Figure 3. Camera positions relative to bridge

Maintenance

On average every 28 to 32 days, a Project field team services the cameras. Arriving by boat, the field team first secures the boat to the pile, loosens the top hose camp, and moves the PVC housing to the boat. There they remove the camera from the two housings, install 4 fresh AA batteries, and swap

out the SD memory card with a newly formatted blank card. They confirm that the camera operated correctly by checking that the SD card contains recorded data. The field team recalibrates the camera's internal date and time, examines the camera's lens and internal housing for any signs of clouding (treating with Rain-X when warranted), and begins recording video. They replace the camera in the housings and return the housing to the channel marker pile ensuring the correct field of view is maintained. The same procedure then occurs at the second camera. Finally, before leaving the scene, the field crew runs the boat through a slow back and forth pattern within the cameras' field of view. This portion of the video provides a reference for video processors since the dimensions of the field crew's boat are known.

Figure 4. Installed camera housing

Video Processing

With the SD memory cards in hand, a quick quality control procedure occurs. The check involves opening each file to identify the timestamp associated with the first frame of the video. The file is subsequently renamed to help identify the location and time period associated with the data. An example of the filename convention is:

"MM_YYYY-MM-DD_HHMMSS.AVI"

where MM stands for the channel marker holding the camera (M1 or M2), YYYY-MM-DD is the year, month, and day associated with the first frame of the video (e.g., 2014-06-08), and HHMMSS is the time stamp of the first frame (e.g., 062152 → 06 = hour (24 hr clock), 21 = minutes, and 52 = seconds).

Video processing results in vessel data entry into a spreadsheet. Reviewers proceed frame-by-frame through the videos and record an entry for each boat observed. Jet skis, kayaks, and paddleboards, as well as boats not passing through the draw span of the bridge are ignored. Entries include the date/time, direction of travel, estimated vessel length, and estimated air draft. On heavy traffic days, determining the sequence of boats passing through the bridge requires careful processing as multiple vessels can appear in a single frame.

In addition to the boat data, the cameras also record bridge operations. At each bridge closure, reviewers record the date/time stamps of a) the first movement of bridge closure, b) the first frame showing the passing train (if any), c) the last frame of the passing train (if any), and d) the first frame of the bridge opening. Both the opening and closing operations consistently run between 80 and 100 seconds (assumed average of 90 seconds). In some instances, the bridge will close without a train crossing. These closures appear to facilitate maintenance operations on the bridge.

Finally, the cameras are set to operate during daylight hours. Each day as the sun sets, the cameras enter sleep mode to conserve both battery power and memory space. Tests activating the low light function of the camera during evening hours proved ineffective. Often when the camera either

enters or comes out of sleep mode the bridge is in the down position. Reviewers record only observed data, so the beginning bridge motion (at dawn) or ending bridge motion (at dusk) may not be visible on the video and are therefore omitted from the spreadsheet. Such entries include a note describing the scene.

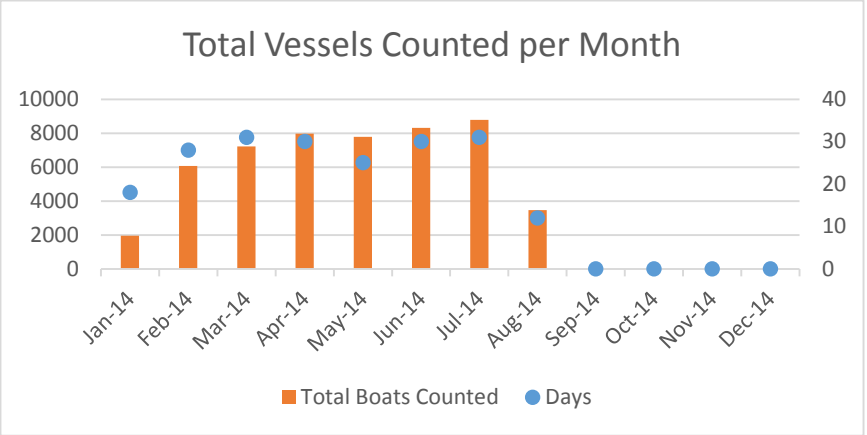
Data Processing

Periodically, the raw data are transferred to a master spreadsheet for further processing and statistical analysis. The master spreadsheet contains the entire vessel and bridge operation record. Several tabs calculate summary statistics for the period of record. The “Boat Stats – Day v Hr” tab calculates the number of boats for each hour of the day for all days in the record. Several histograms present data on the distribution of boats by hour, by boat length, and by air draft. Taylor Engineering presents a series of summary charts to the JID board monthly.

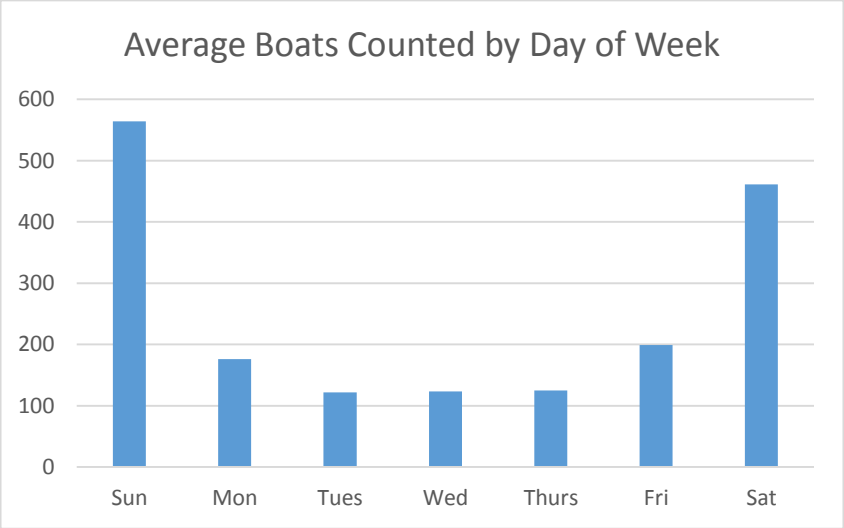
Summary Statistics

The summary statistics presented below cover the period from January 15, 2014 to August 12, 2014. All data represent daylight hours only. During this period reviewers have counted 51,591 boats.

Month	Days	Total Boats Counted	Average Boats per Day
Jan-14	18	1964	109.1
Feb-14	28	6073	216.9
Mar-14	31	7220	232.9
Apr-14	30	7979	266.0
May-14	25	7792	311.7
Jun-14	30	8319	277.3
Jul-14	31	8782	283.3
Aug-14	12	3462	288.5

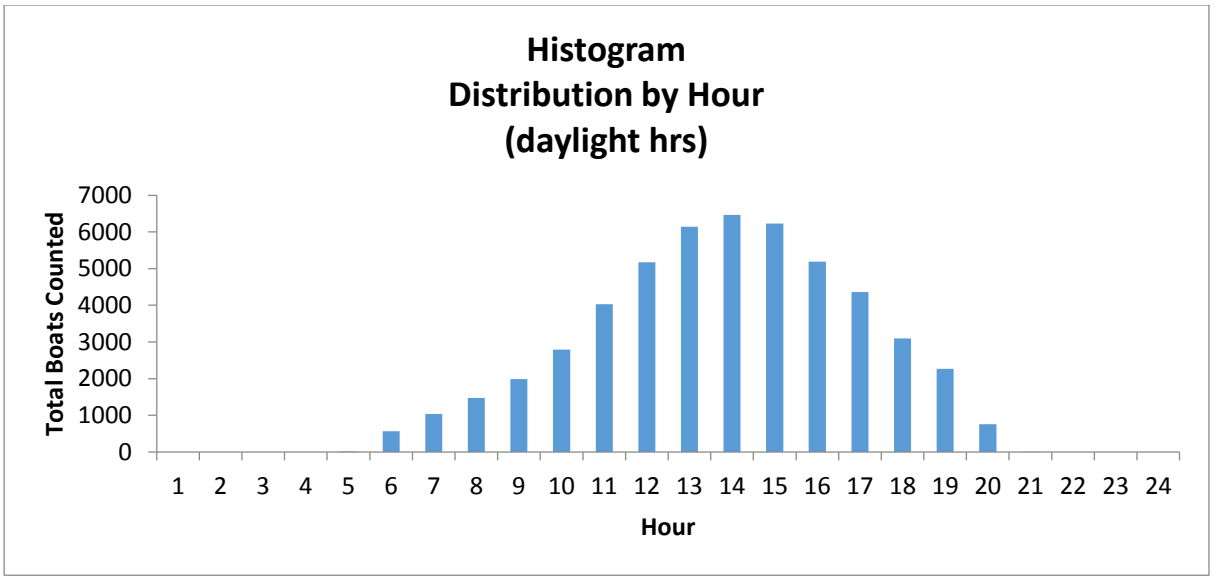


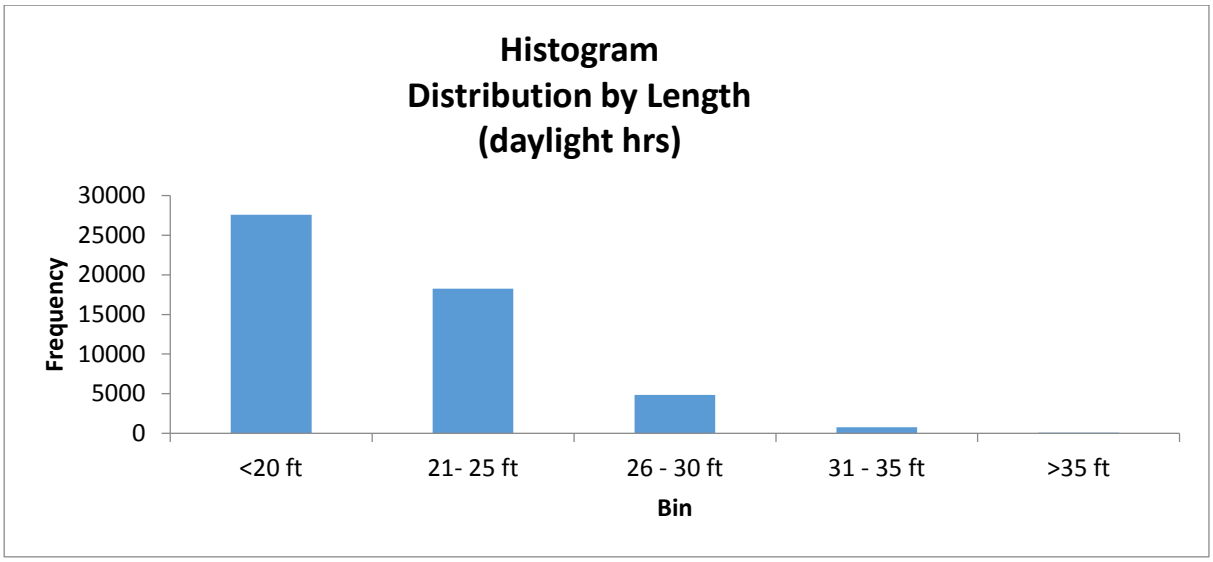
Day of Week	Total Boats Counted	Count	Average Boats Counted
Sun	16,357	29	564.0
Mon	5,102	29	175.9
Tues	3,653	30	121.8
Wed	3,704	30	123.5
Thurs	3,626	29	125.0
Fri	5,773	29	199.1
Sat	13,376	29	461.2
	51,591		

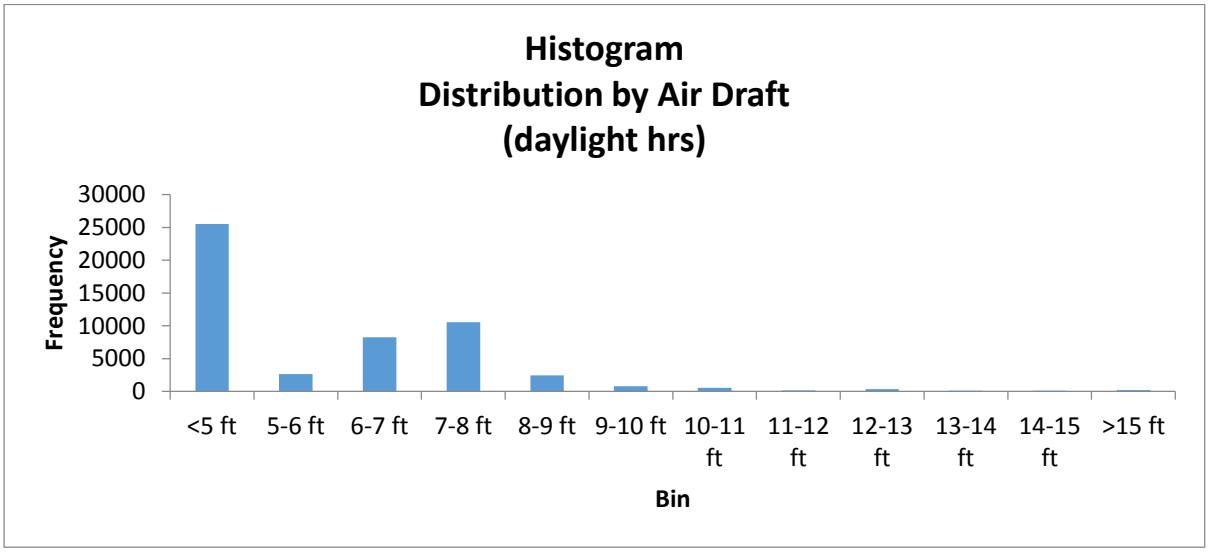


BRIDGE OPERATIONS

	Closing Lead Time	Train Passing	Lag Until Opening	Total Time Obstructed (Train)	Total Time Obstructed (All Closings)
Count	704	733	729	690	919
Average	0:15:13	0:03:29	0:02:03	0:20:21	0:19:23
Std Dev	0:10:43	0:05:11	0:04:31	0:13:10	0:13:41
Max	4:26:20	1:14:57	1:04:43	4:59:20	4:59:20
Min	0:02:37	0:00:00	0:00:40	0:04:00	0:00:00


Histogram
Distribution by Hour
(daylight hrs)
Total Boats Counted
7000
6000
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour


Histogram
Distribution by Length
(daylight hrs)
Frequency
30000
25000
20000
15000
10000
5000
0
<20 ft
21- 25 ft
26 - 30 ft
31 - 35 ft
>35 ft
Bin


Histogram
Distribution by Air Draft
(daylight hrs)
Frequency
30000
25000
20000
15000
10000
5000
0
<5 ft
5-6 ft
6-7 ft
7-8 ft
8-9 ft
9-10 ft
10-11 ft
11-12 ft
12-13 ft
13-14 ft
14-15 ft
>15 ft
Bin