Dayton Boulevard at Morrison Springs Road Safety Analysis Memo

To:	Leslie Johnson	Email:	ljohnson@redbanktn.gov
From:	Geneva Dowdy, PE	CC:	Gregory Tate Jonathan Mills, PE
Phone:	865-934-4147	Date:	February 28, 2025
Project:	Dayton Boulevard at Morrison Springs Road		
Subject:	Intersection Spot Safety Improvements		

1. Introduction

The purpose of this project is to evaluate the study intersection of Dayton Boulevard at Morrison Springs Road for operational and safety improvements. Specifically, the City of Red Bank is interested in pedestrian and bicycle improvements at the intersection. This memorandum will evaluate existing intersection conditions and recommend short term improvements. These improvements will be identified on a conceptual aerial drawing that accompanies this memo. Long term recommendations will be noted in this memo for possible future improvements. The memo will include a brief description of the existing conditions, and a description of the enhancements divided into the short term and long term recommendations.

2. Existing Conditions

A site visit was conducted on Wednesday, March 20, 2024 at the intersection of Dayton Boulevard at Morrison Springs Road in Red Bank, Tennessee. The intersection is a signalized three-legged intersection with commercial frontage lining the eastern side of Dayton Boulevard.

The northbound approach along Dayton Boulevard consists of one dedicated left-turn lane with approximately 60 feet of storage, two through lanes, and one 7-foot on-street parking with no buffer zone. The southbound approach along Dayton Boulevard consists of two through lanes and one free-flow channelized right-turn lane with approximately 195 feet of storage. Although the right-turn lane is 10 feet wide, the lane widens significantly through the free flow channelized portion of the roadway. The westbound approach of Morrison Springs Road consists of two left-turn lanes and one signalized right-turn lane with a right-turn overlap. One of the left-turn lanes is full storage and one has approximately 245 feet of storage. Both Dayton Boulevard and Morrison Springs Road have a posted speed limit of 40 mph within the study area.

Sidewalk is present along all approaches to the study intersection but no buffer zone between the roadway and sidewalk is present. The intersection includes eastbound and southbound marked longitudinal crosswalks that have curb ramps with truncated domes and pedestrian signal heads and pushbuttons. The intersection is equipped with accessible pedestrian signals (APS) which provide auditory and vibrotactile cues for waiting pedestrians.

The crosswalk in the northwest corner of the intersection to the concrete channelizing island presents sight distance issues for pedestrians traveling southbound through the channelized crossing. The current location of the pedestrian curb ramp is located in the center of the radius of the right turn lane. Due to the existing business fencing and geometric curvature of the roadway, sight distance is severely limited for crossing pedestrians. Oncoming vehicles cannot see pedestrians wanting to cross the roadway and were observed to be traveling at high rates of speed.

A rectangular rapid flashing beacon (RRFB) is installed along with a pedestrian crossing warning (W11-2) sign approximately 60 feet before the crosswalk. The RRFB is activated with the existing pedestrian pushbuttons across the southbound crossing.

Streetlighting is present in the northeast and southeast corners of the intersection. Pedestrian lighting is present along both sides of Dayton Boulevard leading up to the study intersection. Pedestrian lighting is present in the northwest corner of the intersection by where the old pedestrian crossing was located, but not adjacent to the newly installed pedestrian crossing through the channelized right turn lane. Bicycle facilities are not present in the study area.

The photo log included in Attachment A shows the existing conditions.

3. Safety Analysis

Five-year crash data containing crashes located within a 250 feet radius around the intersection of Dayton Boulevard at Morrison Springs Road was collected from AASHTOSafetyWare. The data spans from March 1, 2019 to February 29, 2024. The analysis focused on pedestrian and bicycle crashes, serious injury and fatal crashes, locations with a high concentration of crashes, types of crashes, and the conditions in which crashes occurred. Within the five-year analysis period, one crash involving a pedestrian and one crash involving a bicyclist have occurred and neither resulted in a serious injury or fatality. The pedestrian involved crash was a result of the pedestrian crossing the southbound crosswalk without a signal while the northbound left-turn phase was active. The cyclist involved crash occurred when a cyclist traveling northbound on the eastern side of the sidewalk along Dayton Boulevard crossed the First Horizon Bank access and was struck by a vehicle who failed to yield the right-of-way to the cyclist. One suspected serious injury crash occurred when a vehicle traveling eastbound along Morrison Springs Road rear ended another vehicle stopped at the traffic signal. Of all the crashes, the majority occurred during daylight hours, clear conditions, and resulted in property damage only (non-injury) crashes. There was a higher proportion of rear-end and angle crashes than other types. A detailed summary of the crash analysis can be found in Table 1. The crash diagram following Table 1 details all the fatal/serious injury crashes and the bicycle and pedestrian related crashes around the study intersection.

Table 1 – Crash Data Analysis (03/01/2019 – 02/29/2024)

Variable	Value	Percentage
Weather		
Clear	57	60%
Cloudy	10	10%
Rain	8	8%
Other / Unknown	21	22%
Lighting		
Daylight	57	59%
Dark-Lighted	18	19%
Dark-Not Lighted	1	1%
Other / Unknown	20	21%
Crash Type		
Head-On	5	5%
Rear-End	32	33%
Angle	25	26%
Sideswipe	11	12%
Pedestrian / Cyclist	2	2%
Other / Unknown	21	22%
Crash Severity		
Fatal	0	0%
Suspected Serious Injury	1	1%
Suspected Minor Injury	13	14%
Possible Injury	6	6%
Property Damage Only	76	79%
Total	**96**	**100%**

LEGEND

- FATALITY
- SERIOUS INJURY
- NON-SERIOUS INJURY
- PROPERTY DAMAGE

CONDITION CODES

A - B - C - #

A - WEATHER
C = CLEAR
R = RAIN
CLD = CLOUDY
F = FOG
S = SNOW
U = UNKNOWN

B - ROAD SURFACE
D = DRY
W = WET
I = ICY = OTHER
O = OTHER
U = UNKNOWN

C - LIGHTING
D = DAYLIGHT
DKN = DARK NOT LIGHTED
DKL = DARK LIGHTED
DKU = DARK LIGHTING UNKNOWN
DN = DAWN
DS = DUSK
U = UNKNOWN

- NUMBER OF VEHICLES

TIME: A = AM P = PM

- PEDESTRIAN
- MOVING VEHICLE
- (C) CYCLIST
- (B) BUS
- (S) SCOOTER

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City of Red Bank Tennessee

DAYTON BLVD AT MORRISON SPRINGS ROAD
CRASH DIAGRAM
20250228-Dayton Blvd at Morrison Springs Rd-Final Report V2(1)

DRAFT

BARGE DESIGN SOLUTIONS

PROJECT NO. 3854401

MORRISON SPRINGS RD SPOT SAFETY

SCALE: 1" = 50'

5/1/2024
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The crash data in Table 1 shows that a majority of crashes have occurred during well-lit, clear conditions and that 79% of crashes resulted in no injuries. There is a higher percentage of rear-end (33%) and angle crashes (26%) than other types of crashes. The high volume of angle crashes could be due to too short of cycle length for turning vehicles or inadequate clearance intervals that do not allow vehicles to exit the intersection before the next phase begins. The high volume of rear-end crashes could be due to unexpected queueing upstream that causes sudden stops or from choosing to not enter the intersection during the yellow interval due to the timings. The crash diagram shows that there have been no fatal crashes, one suspected serious injury crash, one crash involving a pedestrian, and one crash involving a cyclist during the five-year analysis period. The suspected serious injury crash occurred when the eastbound queue along Morrison Springs Road was stopped and an approaching vehicle rear-ended the vehicle at the end of the queue. The crash involving a pedestrian occurred when a pedestrian traveling southbound across Morrison Springs Road improperly entered the crosswalk during the northbound left-turn phase. The crash resulted in minor injuries for the pedestrian. The crash involving a cyclist occurred when a cyclist was riding northbound on the right side sidewalk of Dayton Boulevard when a vehicle making a southbound left turn into the bank access and the two struck each other. The crash did not result in any injuries. The crash data shows that large concentrations of crashes have occurred eastbound along Morrison Springs Road and within the channelized southbound right-turn lane from Dayton Boulevard to Morrison Springs Road. Eastbound along Morrison Springs Road is where the highest concentration of crashes has occurred, with twenty reported collisions within the five-year analysis period and one resulting in a suspected serious injury. The high crash frequency along this segment could likely be due to high traffic volumes, vehicles exiting from US Highway 27 and maintaining similar driving behaviors, and improper following distance combined with the downgrade slope along Morrison Springs Road that increases safe stopping distances. The southbound channelized right-turn lane along Dayton Boulevard is another location where a high concentration of crashes has occurred, with 12 collisions reported within the five-year analysis period. The crashes at this location were a combination of rear-end, angle, and sideswipe and are likely due to improper following distances, last-minute lane changing, and failure to yield right-of-way. Two head-on collisions have occurred near the intersection of Dayton Boulevard at Unaka Street, where two opposing left-turn lanes meet. This is likely due to vehicles entering the left-turn lane too early and striking oncoming vehicles.

4. Recommendations

Intersection improvement recommendations have been determined based on field observations, crash analysis, and concerns expressed by the City of Red Bank. The recommendations are expected to reduce vehicle speeds, increase pedestrian visibility and warnings to vehicles, increase horizontal offset between pedestrians and vehicles, improve pedestrian mobility, and provide access management.

Recommendations for improvements to the existing crossing have been identified and classified into short term and long-term recommendations. These improvements vary in terms of length of implementation but can range from quickly deployable signage and striping improvements to longer construction countermeasures. The recommendations for improvements as well as their anticipated type of construction for the existing intersection can be found in the table below.

Table 2 - Improvement Recommendations

Type	Improvement	Justification
ST	Install W16-9P "AHEAD" sign below existing RRFB in the northwest corner of the intersection.	Provide additional warning to vehicles about pedestrians crossing the channelized right turn lane.
ST	Install R1-5A "Yield Here to Pedestrian" sign adjacent to yield bars in the northwest corner of the intersection.	Provide additional guidance to vehicles about pedestrians crossing the channelized right turn lane.
ST	Relocate existing pedestrian sign along Morrison Springs Road and replace downward arrow plaque with W16-9P "Ahead" plaque.	Improve advanced warning of pedestrians since existing vegetation hinders visibility of the existing signage.
ST	Install RRFB sign assembly per TDOT STD DWG T-M-4A on both sides of the crosswalk across the southbound channelized right turn lane.	Increase vehicle awareness of pedestrians crossing.
ST	Install R10-15 "Turning Vehicles Yield to Pedestrians" signs on northbound and eastbound mast arms.	Provide additional warning to drivers that pedestrians may be present in the crosswalk.
ST	Restripe approximately 215 feet of retroreflective solid white striping for the southbound channelized right-turn lane along Dayton Boulevard.	Existing pavement marking is worn and faded.
ST	Install approximately 100 feet of retroreflective solid white striping westbound on Morrison Springs Road.	Encourage drivers to stay in their lane while vehicles enter the roadway to improve flow and reduce sideswipe and rear-end collisions.
ST	Install plastic "ONLY" pavement marking 32 feet behind existing right-turn arrows on Morrison Springs Road.	Reduce last-second lane changing by providing drivers with additional warning of lane direction.
ST	Update yellow change interval and red clearance intervals per TDOT Traffic Design Manual.	Provide adequate time for vehicles to clear the intersection before the beginning of the next phase.
ST	Update Max 1 timings with an increase in phase 1 (northbound left) phase length.	Reduce vehicle-vehicle and vehicle-pedestrian conflicts by providing more vehicles to clear during the protected phase.
ST	Coordinate the signals along Dayton Boulevard from Leawood Avenue to Ashland Terrace	Reduce queue spillback and intersection blocking by improving vehicle progression along the corridor.
ST	Remove yield bars in the northwest corner and relocate 30 feet behind proposed crosswalk location.	Maintain proper yield distance with relocated crosswalk.
ST	Install retroreflective curb extension striping in the northwest corner of the intersection for the channelized right turn lane.	Reduce pedestrian crossing distances and slows turning vehicle speeds.
ST	Remove one northern most on-street parking space and install retroreflective curb extension striping and white flexible delineators along Dayton Boulevard.	Provide a horizontal buffer area between the sidewalk and vehicle lanes, reduces pedestrian crossing distances, and reduces outermost lane width which can reduce vehicle speeds.

ST	Install yellow flexible delineators and yellow median striping between northbound left-turn lane and southbound left-turn lane along the southern leg of the intersection.	Reduce conflict points between vehicles traveling opposite directions entering the left-turn lane too early.
LT	Install overhead street lighting with LED fixtures in southwest corner of the intersection on the existing mast arm.	Improve pedestrian visibility.
LT	Relocate the northwest corner crosswalk, curb ramps, and pushbuttons approximately 9 feet north along the channelized island.	Improve pedestrian visibility by increasing sight distance for pedestrians to be seen by oncoming turning vehicles.

ST – Short Term
LT – Long Term Improvement

5. Crash Barriers

Temporary crash barriers were examined as a measure to help protect motorists from crashing into existing building frontage along the east side of Dayton Boulevard. These temporary measures are intended to remain in place until a greater road diet project is studied and implemented along Dayton Boulevard, which would potentially decrease the cross section of Dayton Boulevard and implement traffic calming measures.

One temporary crash barrier considered are water filled jersey barriers. Jersey barriers in general provide a crash barricade around a designated area that can withstand a varying amount of vehicle crash impact at varying speeds. Water filled jersey barriers offer a variety of benefits compared to concrete jersey barriers including:

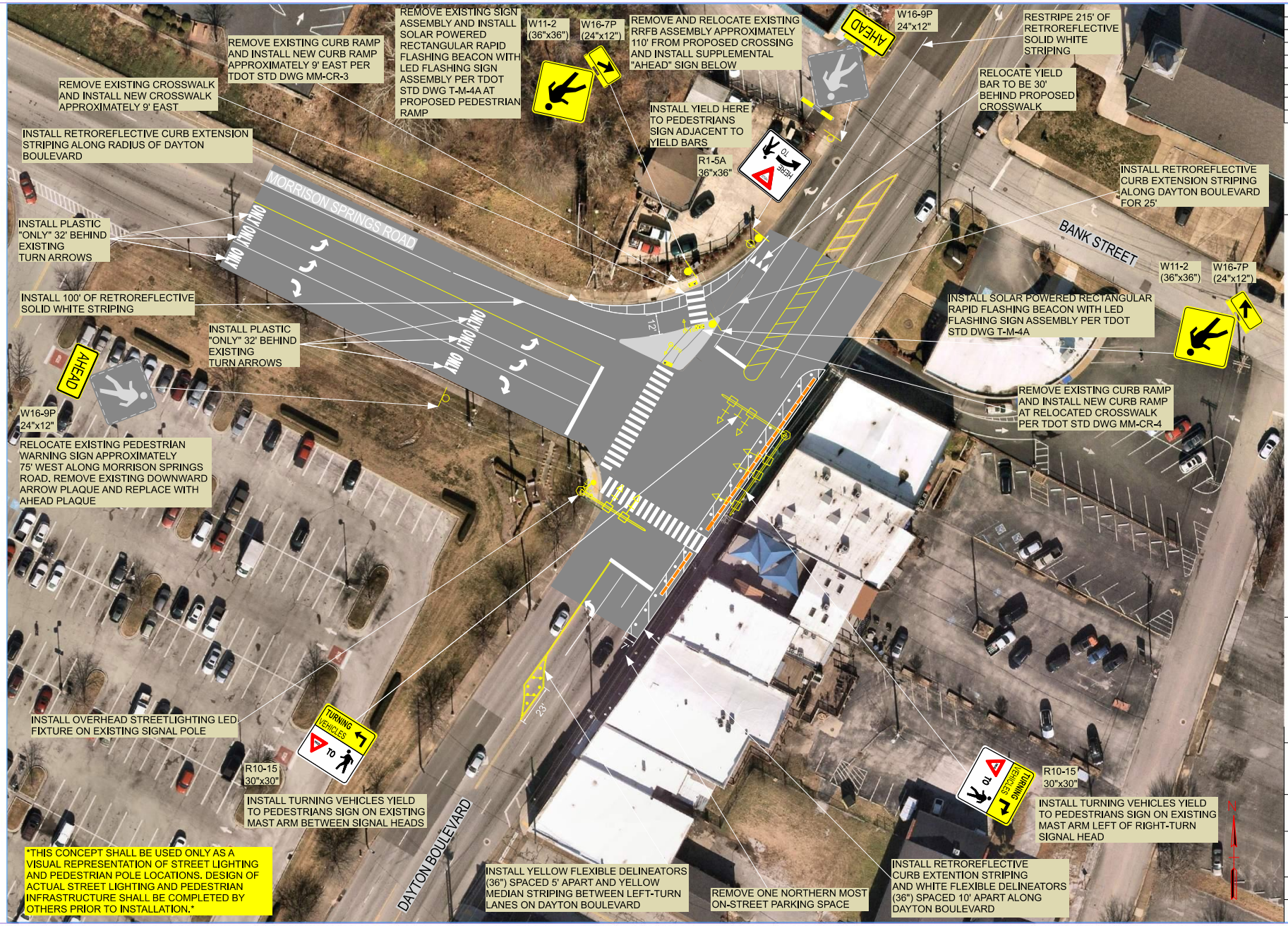
1) Visibility – the outer shell of water filled jersey barriers are fluorescent and bright in color, allowing for greater visibility for drivers compared to a regular concrete colored barrier.
2) Customizability – the plastic shelled jersey barrier allows for better signage customizability due to it's flat plastic surface, allowing the City to install additional retroreflectivity / signage for drivers to see.
3) Durability – water filled barriers made of high-density polyethylene plastics are durable to stand up to not only vehicle impact but also handling and inclement weather, and generally can last for several years in one location with little maintenance.
4) Cost-Effectiveness – water filled barriers tend to cost significantly less than the cost of concrete jersey barriers, especially when considering transportation and material costs.
5) Storage – Ease of storing, stacking, and dismantling of plastic jersey barriers are significantly easier compared to concrete barriers.

Another crash barrier considered were steel crash bollards, to be installed along the sidewalk frontage and spaced approximately 4 feet apart to protect vehicles from striking pedestrians and businesses along the sidewalk. Similar to jersey barriers, crash bollards provide protection against a significant amount of vehicle force rated at different traveling speeds. Crash bollards are typically a more permanent fixture, however removable bollards exist which allow cities the flexibility to temporarily remove bollards for sidewalk maintenance or potential special events.

Standard crash bollards typically have a deeper foundation, on average around 36"– 48" under the ground elevation. This can be less than ideal for more urban areas, which can often have a variety of underground utilities under the sidewalk that could be potential conflicts. In these instances, shallow foundation bollards can be utilized which only require approximately 14"-16" foundation depths.
Given the nature of this quickly deployable project for the City, water filled jersey barriers are recommended as a temporary crash protection measure along the east sidewalk frontage of Dayton Boulevard. Water filled barriers can be quickly deployed, are more visible to drivers compared to other crash barriers, and are durable enough to last until a longer term engineering solution is addressed along Dayton Boulevard.

This study also suggests the consideration of long term more permanent solution of crash bollards to be installed along the business frontage sidewalk if and when a road diet is implemented along Dayton Boulevard.

The exhibit below details the recommended improvements as shown in Table 2 above. These improvements are shown as conceptual and any permanent improvements including pedestrian infrastructure should undergo the full design process prior to installation.



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City of Red Bank Tennessee

DAYTON BLVD AT MORRISON SPRINGS ROAD
SPOT SAFETY CONCEPTUAL PLAN

20250228-Dayton Blvd at Morrison Springs Rd-Final Report V2(1)

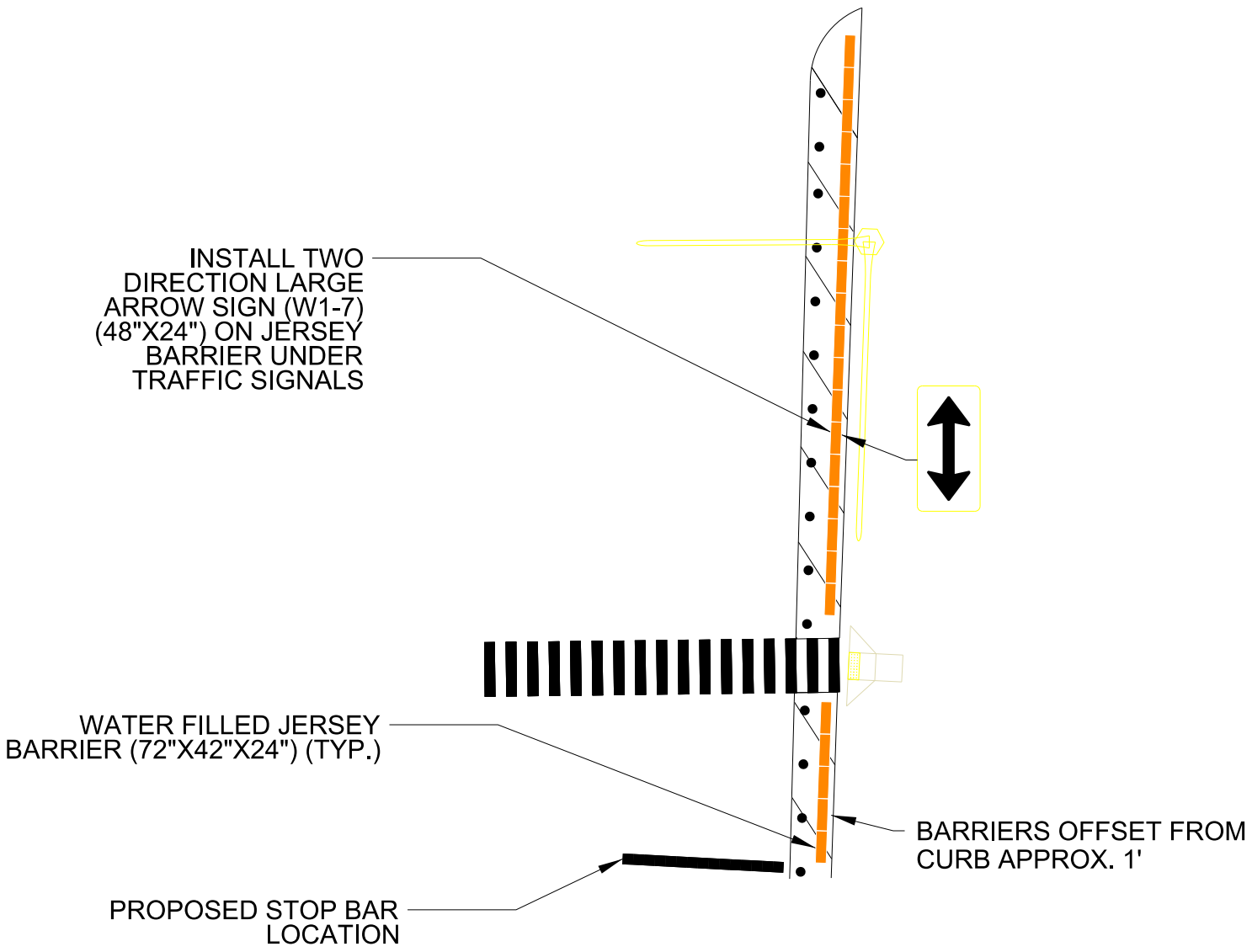
CONCEPT

BARGE DESIGN SOLUTIONS

PROJECT NO. 3854401

MORRISON SPRINGS RD SPOT SAFETY

SCALE: 1" = 50'



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DAYTON BLVD AT MORRISON SPRINGS ROAD
JERSEY BARRIER CONCEPTUAL LAYOUT
20250228-Dayton Blvd at Morrison Springs Rd-Final Report V2(1)

CONCEPT

PROJECT NO. 3854401

MORRISON SPRINGS RD SPOT SAFETY

NOT TO SCALE

ATTACHMENT A – PHOTO LOG

Figure 1 – Looking eastbound across Dayton Boulevard (Southwest corner)

Figure 2 – Looking northbound across Morrison Springs Road (Southwest corner)

Figure 3 – Southwest Corner Pushbutton for crossing Morrison Springs Road

Figure 4 – Southwest Corner Pushbutton for crossing Dayton Boulevard

Figure 5 – Looking northbound across Dayton Boulevard at channelized island

Figure 6 – Northwest Corner New Pedestrian Signal Head with Pushbutton on Channelization Island

Figure 7 – Northbound Channelization Crosswalk across Dayton Boulevard

Figure 8 - Northwest Corner New Pedestrian Signal Head with Pushbutton at channelized crossing

Figure 9 – Southeast Corner Pushbutton for crossing Dayton Boulevard

Figure 10 – Northbound Sidewalk along east side of Dayton Boulevard

Figure 11 – Looking westbound across Dayton Boulevard (Northeast corner)

Figure 12 – Looking northbound from existing pedestrian crossing (northwest corner)

Figure 13 – Southbound Approach of Dayton Boulevard

Figure 14 – Southbound Channelized Right Turn Lane of Dayton Boulevard

Figure 15 – Northwest Corner Curb Ramp

Figure 16 – Eastbound Approach of Morrison Springs Road

Figure 17 – Westbound receiving lanes of Morrison Springs Road

Figure 18 – Southeast Corner Curb Ramp

Figure 19 – Northbound Approach of Dayton Boulevard