

## NOTES ON COUNTERMEASURE SERVICE LIFE, MAINTENANCE COSTS, AND UTILITY COSTS UPDATE

### Overhead Lighting

- A single overhead light averages \$120 per year in direct power costs to NCDOT.
- Typical maintenance costs are ½ of utility costs per year or \$60 per year per light direct costs to NCDOT (old style bulbs). New LED bulbs should be much less.
- The service life of the LED bulbs is 20 years.
- The service life of the poles is 50 years.
- Lighting Group is encouraging the Divisions not to install NCDOT owned lighting. The recommendation is to lease utility owned lighting through an encroachment agreement with the Utility Company. The costs for this is \$25 per month per pole and includes power and maintenance. The contract is 10 years.
- *For Rural Roundabouts*
- Lighting Group recommends 4 lights at the roundabout with 2 additional on each approach for 12 total lights.
- $\$25 \times 12 = \$300$  per month or \$3600 per year total costs.
- *For Rural Intersections*
- Lighting Group recommends 4 lights at the intersection with 1 additional on each approach for 8 total lights.
- $\$25 \times 8 = \$200$  per month or \$2400 per year total costs.
- *For Sections*
- Lighting Group recommends 1 light every 200 feet.
- If the average project is ¼ mile in length then 1,320 feet (1/4 mile) would need 6.6 or 7 lights.
- $\$25 \times 7 = \$175$  per month or \$2100 per year.
- Service Life should be 10 years based on the contract length with the utility provider (typically Duke Power).

*Information was provided by Greg Hall, Lighting and Electrical Team Lead 2/5/2020*

### Traffic Signals, Flashers and Related

Signal Maintenance Costs – use \$2700 for signals based on Anna Henderson’s analysis in e-mail dated 2/6/2020:

Division 13 Analysis:

- Loops- \$100 per intersection. 600 intersections is \$60,000 a year.
- Operational Review Labor/Truck/Parts \$300 per intersection, 600 intersections twice per year \$360,000
- NJuns Tickets/Pole Transfers: Labor/Truck-\$15,303
- Citizen Action Requests (Average 156 per Year): Labor/truck- \$35,162
- Locates (Average 618 e-mails a month with only Fiber and Mast Arms on NC811): Locate personal, Truck, and materials \$140,000

- Revision to signals per year-\$100,000
- LED Change outs \$1500 per intersection at 120 locations per year- \$180,000
- Railroad inspections \$3000 per intersection at 8 locations per year-\$20,000
- 3 or 4 Timing corridors per year-\$150,000
- We average 10 upgrades a year at a minimum of 35,000 each-\$350,000
- Trouble calls/Knock downs cost per year-\$70,000
- Power/Telephone services per year-\$145,000

Total: \$1,625,465

Divided by 600 Locations

Equals: \$2709.11

Signal Utility Costs – Jason Galloway reviewed the existing utility costs for signals, flashers and related devices. Power bills vary widely depending on the complexity of the traffic signal and what part of the state it is in. Based on Jason’s review, the existing utility cost estimates for signals, flashers and related devices is accurate and does not need to be adjusted.

Closed Loop Signal Systems – Retiming costs would average \$5,000 per signal done twice over the course of 10 years. Additional utility costs would be just for the modem - \$40 per month.

So Maintenance Costs = \$10,000 per signal per corridor over 10 year service life or \$1,000 per year per signal.

*Per Matt Carlisle, State Signal Systems Engineer*

Concrete Islands, Roundabouts, turn lanes and widening for an Additional Lane

Keep \$800 per year for concrete related countermeasures to cover increased maintenance related to build up of material at inlets, increase in rate of replacement of signs, concrete repair and replacement. This number applies to a wide range of project types and sizes.

Keep \$2500 annual maintenance cost for roundabouts to cover landscaping, increased sign maintenance, increased maintenance of concrete islands and other variable items such as flashers. This does not include overhead lighting, which is covered in the lighting section.

Keep \$250 per lane for annual maintenance for turn lanes. This appears to be accurate for the typical turn lane, based on a review and discussion regarding maintenance budgets with Division 6. Division 6 annual maintenance budget is \$70 million or \$12,00 centerline mile (includes everything).

Annual Maintenance for lane widening from Statewide Maintenance Unit (Emily McGraw):

\$4,500 per lane mile for the Secondary Road System.

\$8,000 per lane mile for the Primary Road System.

### Signs and Markings

Per guidance from Matt Springer, 5 years for long life markings is a good average life span. On low volume secondary roads the expected life of the markings will be longer. On high volume primary roads it may be less.

Based on the recently completed study by NC State, NCDOT is revising the service life of all signs to 20 years per Kevin Lacy and Renee Roach.

NC State study references another study that indicates an annual sign damage rate of 4.04% (Rasdorf et al, 2006).

It also references a study that estimates the annual spot replacement rate of damaged signs at 41.09% (Rasdorf and Machado, 2018).

So, the estimated annual maintenance costs for signs would be 41.09% of 4.04% or 1.66% of the initial cost of the signs over the 20-year service life.

### Interchanges and Grade Separations

Structures Management estimates the cost of maintaining the 'typical' bridge to be \$100,000 over a 50-year service life. So, the expected annual maintenance cost increase where a new structure is constructed is \$2,000 per year. No additional maintenance cost is assumed where an existing grade separation is replaced by another design (diamond to diverging diamond for example).

### Continuous Flow Intersection

Assume 2 additional signals (could be more). Also include the \$800 additional maintenance cost for channelization. So annual cost would be:

$\$2700 \times 2 = \$5,400$  for new signals.

\$800 for channelization.

\$6200 increase in annual maintenance costs.

$\$475 \times 2$  new signals = \$950 increase in annual utility costs.

### Median Barrier and Guardrail

The following data was provided by Bucky Galloway, James Laughride (Division 13) and also based on estimates in the *Roadside Safety Devices* brochure – 4<sup>th</sup> edition (NCDOT).

- Median barrier (double faced): Total cost of repair = \$5,000 per 100' section
- Shoulder guardrail: Total cost of repair = \$4,000 per 100' section
- Cable guiderail: Total cost of repair = \$1,200 per 100' section

Approximately 75% of the barrier repair costs are being reimbursed by insurance companies.

If we go with an average repair length of 50' for median and shoulder guardrail (James was okay with this) and the 75% reimbursement rate, the total cost of repair for each would be:

- Median Barrier: Total cost per crash =  $\$5,000/2 \times 0.25 = \mathbf{\$625}$

- Shoulder guardrail: Total cost per crash =  $\$4,000/2 \times 0.25 = \mathbf{\$500}$

For cable barrier, James says the average hit takes out 6 to 7 posts so he would recommend a length of 100'. There are 8 posts in a 100' section. So using 100', the total cost per repair would be:

- Cable barrier: Total cost per crash =  $\$1,200 \times .25 = \mathbf{\$300}$ .

For concrete median barrier, the estimate from the brochure is \$2500 per crash. Using the insurance estimate of 75% reimbursement, the annual maintenance cost to NCDOT for concrete barrier would be **\$625**.

The service life for all barriers was adjusted from 10 years to 20 years. This is based on past performance. The service life for end units was left at 10 years with no annual maintenance costs. The service life adjustment was made with input from Shawn Troy, Haywood Daughtry and Bucky Galloway.

### Open Graded Friction Course

Note below from Division 13 provided by Bucky Galloway:

10 years is about what we expect out of OGFC as well. Can be a little less or a little more based on traffic volumes. There is not an appreciable milling cost for removal of the material that I am aware of. Usually, when it's time to remove it, the milling is pretty easy.

**Timothy W. Anderson, P.E.**

Division Maintenance Engineer

Division 13

### Railroad Crossing

2020 revisions were made based on feedback from the Rail Division. The following is the feedback received from Richard Mullinax on 2/25/2020:

#### 9.16.1 Install New Traffic Signal with Railroad Preemption

- Please verify service life, maintenance, and utilities are consistent with a non-preempted traffic signal except add an additional \$726 to the maintenance. The \$726 to maintenance reflects new maintenance rates the State reimburses the railroad for traffic signal preemption locations.

#### 9.17.1 Install Railroad Preemption at Existing Traffic Signal

- Change maintenance cost from \$500 to \$726. This reflects new maintenance rates the State reimburses the railroads for this type of device.

#### 9.19.1 Install Gates at Railroad Crossing with Flashing Lights and Sound Signals

- Change description to "Install Gates at Railroad Crossing with Flashing Lights and Bell."
- Change service life from 18 years to 25 years. The addition of gates will most likely necessitate replacement of existing protective devices and as part of its selection process for crossing signals projects, Rail Division is considering 25 years as "aging infrastructure" for potential replacement purposes.
- Change maintenance cost from \$516 to \$616. This reflects the difference in maintenance costs between the existing level of protection with no gates to the proposed level of protection with

gates as well as new maintenance rates reimbursed to the railroad for this type of device.  
(\$1,830 w/ gates less \$1,214 w/o gates equals \$616 difference)

#### 9.20.1 Install Overhead Cantilever with Flashing Lights at RR Crossing with Existing Lights and Gates

- Change service life from 18 years to 25 years. The addition of new light pairs with the added electric current draws may necessitate replacement of existing protective device components and, as part of its selection process for crossing signals projects, Rail Division is considering 25 years as “aging infrastructure” for potential replacement purposes.
- Change maintenance cost from \$1,026 to \$0. The addition of a cantilever to the existing protective devices will not change the current maintenance rates paid by the State. The devices will remain in the same class for purposes of maintenance reimbursement.

The following are additional observations I made in reviewing the spreadsheet.

- The crash reduction percent for 9.1 Grade Separation is 90%, yet 98% for 9.9 Four Quadrant Gates and Median Barriers. As category 9.9 was based on observational counts in FRA report and 9.1 was subjective by committee consensus, we request consideration of increasing the percentage for 9.1 to 100%. Grade separations are by far the safest form of a railway-highway crossing, essentially eliminating all targeted crashes.
- Likewise, the crash reduction percentage for 9.10 Close Existing At-Grade Crossing is 90% based on committee consensus versus 98% for 9.9 Four Quadrant Gates and Median Barriers. We request consideration for increasing the percentage for 9.10 to 100%. Removal of a crossing essentially eliminates all targeted crashes as there is literally no longer a crossing in existence.
- The crash reduction percent for 9.5 Switch Legs of Stop Sign Control at a Railroad Crossing is “none.” This was determined by committee consensus. We request consideration of making this percentage  $\frac{1}{2}$  of the percentage for 9.1 Grade Separation. This would acknowledge that relocation of the stop signs will alleviate the potential for vehicles stopping on the track and hence reduce the likelihood of crashes, while also recognizing that the potential for intersection crashes remains.