FEASIBILITY STUDY FS-1001A



INFRASTRUCTURE REPAIR AND PEDESTRIAN IMPROVEMENTS **BUXTON AND HATTERAS VILLAGES DARE COUNTY, DIVISION 1**



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FEASIBILITY STUDY

FS-1001A

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I - INTRODUCTION

This feasibility study evaluates infrastructure and pedestrian improvements along NC 12 in Buxton and Hatteras Villages, Dare County. The study includes 0.7 miles of NC 12 in Buxton and 0.9 miles in Hatteras. (See Figure 1.) The scope of project improvements includes repair/ replacement of existing stormwater systems, installation of curb-and-gutter and sidewalks, and resurfacing and widening of the existing roadway.

This is the initial step in the planning and design process for the candidate project and not the product of exhaustive environmental or design investigations. The purpose of this study is to describe the proposed project including cost, and identify potential problems that may require consideration in the planning and design phases.





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II - EXECUTIVE SUMMARY

This feasibility study considers stormwater system repair/replacement and pedestrian improvements to 0.7 mile of NC 12 in Buxton village and 0.9 mile in Hatteras village in Dare County. NC 12 is the primary route for all of Hatteras Island and is a National Scenic Byway. Project goals and concepts have been initiated by the Outer Banks National Scenic Byway Committee with input from the Division, local officials, and local property owners. They have been further developed through this feasibility study. Two local small group meetings were held during the study's concept development.

This study recommends resurfacing and widening NC 12 to 15-foot travel lanes with 2½-foot curb-and-gutter and 5-foot concrete sidewalks on 10-foot berms within state-maintained right-of-way. On-street parallel parking is recommended in the central district of Hatteras village. The roadway drainage systems are to be replaced with the roadway improvements. The improvements are to be constructed within existing right-of-way, temporary construction easements and permanent drainage easements. Permanent drainage easements are needed for outlying pipes that connect to NC 12 roadway drainage systems and do not have any current maintenance agreements.

The Buxton studied alternatives include the typical section improvements described above and optional designs at both Buxton Back Road and Dillon's Corner store. The total estimated costs, not including bioretention/bioswale or lighting, for the Buxton studied alternatives range from \$ 3,975,000.00 to \$ 4,250,000.00.

The Hatteras studied alternatives include optional designs at the Kohler Road intersection in addition to the typical section improvements described previously. On-street parking is proposed in front of Wing's/Sonny's and in the central village district. Three (3) short retaining walls are needed to protect two cemeteries and replace a landscaping wall. The total estimated costs, not including bioretention/bioswale or lighting, for the Hatteras studied alternatives range from \$ 5,925,000.00 to \$ 6,025,000.00.

Bioretention/Bioswale streetscape "retrofits" in the available green space and permeable pavement for on-street parking stalls are stormwater quality treatments that could be utilized within the proposed roadway footprint. It is estimated that 20,100 square feet of green surface area is available for bioretention within the Buxton roadway footprint at a cost of \$ 460,000.00 and 24,600 square feet in Hatteras at a cost of \$ 685,000.00. Costs for these treatments are not included in the recommended alternatives; they may not be cost effective or treat enough volume of runoff.

It is estimated that street lighting for the Buxton village study area will cost an additional \$ 92,000.00; and \$ 159,000.00 for the Hatteras village study area. No proposed lighting was included on the south

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side of NC 12 from Buxton Back Road to Lighthouse Road. These costs are not included in the recommended alternatives.

III - PURPOSE AND NEED

NC 12 is the primary route for all of Hatteras Island and is a National Scenic Byway. As such an important route for Hatteras Island villages, the Outer Banks National Scenic Byway Committee has developed the project concept in their <u>Off-Road Pathways Plan for Hatteras Island Villages</u> (August 2006) and their <u>Corridor Management Plan</u> (December 2008, pp. 59-60, 69-70). The Dare County Board of Commissioners and the Albemarle RPO support the project. Infrastructure and pedestrian improvements in the villages, as described in the plans mentioned above:

- ► Provide safer routes for drivers, pedestrians and cyclists,
- Calm traffic and reduce unsafe driving maneuvers,
- ► Improve roadway drainage and reduce street flooding,
- ▶ Promote cleaner water in the Pamlico Sound, and
- Define the village centers more clearly.

These project goals have been further developed through this feasibility study with input from the Committee, the Division, local officials, and other local stakeholders. Two local small group meetings were held during the study's concept development; one to garner input on the scope of the project and one to review the functional concepts before estimating costs.

IV - EXISTING CONDITIONS

NC 12 on Hatteras Island is functionally classified as a Major Collector/Major Thoroughfare. The posted speed limit through Buxton is 25 mph from Buxton Back Road to Old Lighthouse Road and is 35 mph from Old Lighthouse Road to the northeast study limits. North of the study area, it increases to 55 mph. The posted speed limit through Hatteras village is 25 mph. The speed increases to 35 mph as you travel east towards Frisco.

The Buxton study area is mostly a commercially developed area with gas stations, a bank, car shops, watersports, restaurants, hotel/motel/rental properties, grocery stores, souvenir shops, the community recreation center, and some residential properties. Cape Hatteras Lighthouse, the point and campground are to the south.

Hatteras village is a mix of residential, commercial (shopping, grocery stores, restaurants, rental agency, hotel/motel, an art gallery, a hardware store, and a bank), community (post office, fire station, library, community building, church, medical center) and natural areas. There is also the Hatteras Marina to the north and the Hatteras Sands Camping Resort along the Slash Creek.

Based on 2011 NCDOT traffic surveys, roughly 9,000 annual average daily traffic (AADT) traveled through Buxton and 4,000 AADT traveled through Hatteras. Refer to Figure 2 Traffic Data. It is

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anticipated that NC 12 will continue to operate at satisfactory levels-of-service. No project-wide traffic forecast or analyses were performed for this study and should be provided in subsequent stages of the project development. (An analysis has been provided for the Hatteras village Kohler Road intersection. See **V. Studied Alternatives Hatteras Alternatives** below.)

The existing typical section is two-lane roadway with 11-foot travel lanes, 4-foot paved shoulders on 8-foot total shoulders. A segment of sidewalk exists on the south side of NC 12 from Buxton Back Road to Lighthouse Road. There are wide, undefined paved shoulder areas at business parking lots and driveways in both villages. Based on a July 28, 2010 NCDOT R/W Abstract (with information from March 13, 1979), there is 60 feet of existing right-of-way through the Buxton and Hatteras study areas. NC 12 has 100 feet of existing right-of-way north of the Buxton study area.

The following crash rate analysis was performed by the NCDOT Traffic Safety Unit:

The 2010 annual average daily traffic (AADT) for this section of NC 12 in Buxton was estimated at 7,400 vehicles per day, and equates to a total vehicle exposure rate of 6.79 million vehicle miles traveled (MVMT).

A total of 10 crashes were reported along this location between July 1, 2008 and June 30, 2011. For crash rate purposes, this section can be classified as a 2-lane undivided, urban NC route. **Table 1** shows the comparison of the crash rates for NC 12 versus the 2007-2009 statewide crash rates and the calculated critical rates with a 95% level of confidence for a comparable route type and configuration. The fatal crash rate exceeds the critical rate for similar type facilities. Note that short segment lengths tend to artificially inflate crash rates.

TABLE 1 - BUXTON CRASH RATE ANALYSIS					
Rate	CRASHES	CRASHES PER 100 MVM	STATEWIDE RATE 1	CRITICAL RATE ²	
Total	10	147.27	224.99	327.04	
Fatal	1	14.73	0.68	13.25	
Non-Fatal	2	29.45	76.03	138.44	
Night	2	29.45	46.90	97.50	
Wet	6	14.73	36.53	82.05	

¹ 2007-2009 statewide crash rate for a 2-lane undivided NC Route.

² Based on the statewide crash rate (95% level of confidence).

No crash rate analysis was performed in Hatteras since only one crash was found within the study limits during the three-year period.

V - STUDIED ALTERNATIVES

The development of the studied alternatives included input from local stakeholders. In addition to customary coordination with the Department and local officials, two small group meetings were held in Hatteras village. As a result, local insight was shared, additional background information was provided, studied alternatives were refined, and optional designs have been included at two locations in Buxton and one location in Hatteras.

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The studied alternatives include proposed roadway and drainage system improvements. Potential stormwater quality treatment and street lighting are also considered. The improvements will be constructed within existing right-of-way, temporary construction easements and permanent drainage easements. Permanent drainage easements are included for outlying pipes that connect to the roadway drainage and do not have any existing maintenance agreements.

A. TYPICAL SECTION

The studied alternatives include resurfacing and widening NC 12. The proposed typical section, as shown on **Figure 3 Typical Section No. 1**, is a two-lane roadway with 12-foot travel lanes and 3-foot additional offsets, 2½-foot curb-and-gutter, 5-foot concrete sidewalks on 10-foot berms, and no control-of-access within the state-maintained right-of-way. The 3-foot offsets and 2-foot gutter pans provide space for experienced on-street cyclists. The Dare County Board of Commissioners recommended this typical in their original 2009 project request. This also follows the <u>AASHTO Guidelines for Planning</u>, <u>Design and Operation of Bicycle Facilities</u>, 2012. **Typical Section No. 2** includes 7-foot wide on-street parking and is for specified segments in Hatteras village.

B. ROADWAY DRAINAGE SYSTEM CONCEPTS

The study team has prepared roadway drainage system concepts in conjunction with roadway improvements described above. They are based on available GIS data and field surveys conducted by Dare County and RK&K. The existing drainage pipes will require replacement in order to connect them to the proposed curb-and-gutter system. Approximately 20 drainage boxes in Buxton and 25 in Hatteras will be needed with the new drainage systems. The drainage system concepts are shown on **Figures 4 thru 7** and are included in the alternatives and costs described herein.

The roadway drainage concepts make use of: Elliptical Pipes, Parallel Pipes, Concrete Pipes, and Tide Gates/Check Valves. See also **Appendix A – Stormwater Concepts**. Tide Gates/Check Valves are included as a measure of reducing tide- and wind-driven street flooding in Hatteras village. A newer, low-maintenance type is the TideFlex duckbill check valve. The City of Wilmington has several of these devices in use. Concrete Pipes are proposed (instead of corrugated metal pipes) for their anti-corrosion qualities and better hydraulic conveyance. Elliptical and parallel pipes can convey roadway drainage in shallower trench depths and achieve needed pipe slopes in flat, coastal areas such as Buxton and Hatteras. Permanent Drainage Easements will provide space for the construction and maintenance of drainage pipes that extend out from the roadway.

C. BUXTON ALTERNATIVES

The study includes 0.7 miles of NC 12 in Buxton; beginning 300 feet west of Buxton Back Road and ending at the northeastern village limit. See **Figures 4 and 5**. The proposed roadway typical section, as described previously and shown in **Figure 3 Typical Section No. 1**, includes widening, curb-and-gutter, sidewalks and roadway drainage. Local stakeholders are not in favor of having on-street parallel parking in Buxton.

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The Buxton studied alternative has been broken into four sections; A through D. There are optional designs in Sections A and C. Buxton village improvements are described below:

Section A includes improvements to the first 0.1 mile (600 feet) along NC 12. There is an existing 5-foot path/sidewalk along the south side of NC 12 from Buxton Back Road to Lighthouse Road (through Sections A and B). It was constructed with the 2009 Buxton Back Road Pathway project. One cross pipe to be replaced extends southward between the RBC Bank and Cape Point Car Shop and requires permanent drainage easement. The retaining walls proposed in Section A protect existing buildings and reduce the need for proposed R/W. See **Figure 3 Detail A** illustration.

There are two optional designs in Section A: **Section A Option 1** proposes widening improvements along the north side of NC 12 and includes a short retaining wall to protect the residential property frontage at 47152 NC Hwy 12 (as seen below). The property currently has an asphalt paved front slope.



The Division Engineer recommended **Section A Option 2**, which adds a left-turn lane onto Buxton Back Road. The option requires some new R/W on both sides of the road, and two short retaining walls; one the same as Option 1 and one to protect the Orange Blossom Bakery & Café at 47206 NC Hwy 12. Although no traffic analysis was performed on this intersection, the additional left-turn lane is likely to improve safety and operations.

The following costs have been determined based on **Section A Option 1** improvements:

Section A Option 1 Cost	\$ 525,000.00
Right-of-Way	\$ 200,000.00
Construction	\$ 325,000.00

It is anticipated that **Section A Option 1** will affect 10 tax parcels and require no relocations.

The following costs have been determined based on **Section A Option 2** improvements:

Construction	\$ 475,000.00
Right-ol-way.	\$ 300,000.00
	• / / • · · · · · · · · · ·

It is anticipated that **Section A Option 2** will affect 13 tax parcels and require no relocations.

Section B includes the next 0.3 mile along NC 12 from 300 feet east of Buxton Back Road to 250 feet west of Old Lighthouse Road. The existing 5' path/concrete sidewalk continues along the south side of NC 12 to Lighthouse Road. No widening is proposed on the south side of NC 12 in this area. Widening, curb-and-gutter, and sidewalk improvements are proposed along the north side of NC12 to Lighthouse Road



and along both sides from Lighthouse Road to 250 feet west of Old Lighthouse Road. The left-turn lane onto Lighthouse Road (at the entrance to Cape Hatteras Lighthouse) is maintained.

The following costs have been determined based on **Section B** improvements:

Section B Cost	\$ 1,225,000.00
Right-of-Way	\$ 300,000.00
Construction	\$ 925,000.00

It is anticipated that **Section B** will affect 20 tax parcels and require no relocations.

Section C includes 0.1 mile (500 feet) along NC 12 at the SR 1231 (Old Lighthouse Road) intersection. The Fessenden Recreation Center, Dillon's Corner Store/gas station, Red Drum Auto/Shopping/Fishing Center, and the Comfort Inn Hotel are in Section C.

Red Drum property owners expressed long-standing concerns with the roadway drainage and its connection to their parking lot at the small group meetings. Corrugated metal drainage pipes in their parking lot connect to NC 12 drainage pipes and have corroded and collapsed in places. They requested rerouting drainage around their property to help improve the situation. In addition to replacing the cross-pipe in the Red Drum parking lot, roadway drainage pipes are proposed along Old Lighthouse Road (within existing right-of-way) to reroute some of the drainage.

This existing pipe system extends northward across NC 12, outside existing NCDOT R/W and beside the Fessenden Center. There are no current agreements or easements for DOT to maintain these outlying pipes on the Red Drum, Dillon's Corner and Fessenden properties. At the Division Engineer's request, costs for permanent drainage easements and upsizing pipes have been included.



Optional designs are provided in Section C and shown on **Figure 5**. Dillon's Corner Store parking spaces are mostly within existing R/W and right off of the travel lanes (as seen in the photo above). The proposed widening, curb-and-gutter and sidewalk would impact their parking. There is potential to widen more towards the south side of NC 12, but care should be taken to avoid the Red Drum gas pumps and Comfort Inn driveway.

For this study, with input from the OBX Scenic Byway Committee and local stakeholders, **Section C Option 1** takes the proposed path away from NC 12, along the Rec. Center's driveway and ball



NCDOT FEASIBILITY STUDY FS-1001A Page 7 of 15 field (on County property), behind Dillon's Corner Store and back to NC 12 (at station 40+50). The Committee has also proposed a crosswalk beside the Rec. Center's driveway. No curb-and-gutter or sidewalk would be constructed in front of Dillon's Corner Store with this option.

Section C Option 2 does construct curb-and-gutter and sidewalk with symmetric widening; as shown in the proposed typical section. In this scenario, the off-the-road path to Fessenden Center would be constructed under a separate project. The Dillon's Corner parking lot would need to be relocated behind the roadway widening and sidewalk. There is room to relocate about 12 of the original 19 parking spaces. Although the design team thought parallel parking had potential at this location, the Committee and local stakeholders were not in favor of it.

The following costs have been determined based on **Section C Option 1** improvements:

Section C Option 1 Cost	\$ 900,000.00
Right-of-Way	\$ 350,000.00
Construction	\$ 550,000.00

It is anticipated that **Section C Option 1** will affect 5 tax parcels and require no relocations.

The following costs have been determined based on **Section C Option 2** improvements:

Section C Option 2 Cost	\$ 925,000.00
Right-of-Way	\$ 325,000.00
Construction	\$ 600,000.00

It is anticipated that **Section C Option 2** will affect 5 tax parcels and require no relocations.

Section D includes the last 0.2 mile within the Buxton study area, from 250 feet east of Old Lighthouse Road to the northeastern village limit. The studied improvements include proposed roadway widening, curb-and-gutter, sidewalks, and drainage systems. There are several oceanfront motels and cottages in this section.

Local stakeholders expressed concerns with frequent street flooding and sand washing on Oramar Drive. The raised elevation of the Comfort Inn property may be a contributing factor. They requested an additional cross pipe connection to the proposed curb-and-gutter system to help improve the situation. Although this problem is not directly tied to NC 12, an additional pipe and permanent drainage easement have been added to the scope and cost of the study.

An existing pipe system extends westward outside existing NCDOT R/W across from the Outer Banks Motel and behind the Island Perks diner (station 46+00). There are no current agreements or easements for the DOT to maintain these outlying pipes. At the Division Engineer's request, costs for permanent drainage easements and replacing pipes have been included.

The following costs have been determined based on **Section D** improvements:





Section D Cost.	\$ 1,325,000.00
Right-of-Way	\$ 425,000.00
Construction	\$ 900,000.00

It is anticipated that Section D will affect 10 tax parcels and require no relocations.

D. HATTERAS ALTERNATIVES

The study includes 0.9 miles of NC 12 in Hatteras; beginning at the western Slash Creek bridge (Bridge #63) and ending at the eastern Slash Creek bridge (Bridge #8), traveling from the Ferry Terminal towards Frisco and Buxton. See **Figures 6 and 7**. The Hatteras studied alternative includes the roadway, curb-and-gutter, sidewalk and drainage system improvements as described previously and shown on **Figure 3 Typical Section No. 1**. On-street parallel parking has been included through the central district of Hatteras village (see **Figures 6 and 7** and **Typical Section No. 2**). There is also the potential use of 24,600 square feet of surface area for bioretention within the footprint of the roadway improvements.

Section A includes improvements to just over 0.7 mile of NC 12 from the western Slash Creek bridge to just west of Kohler Road. Three (3) short retaining walls are needed in Section A; two to protect centuries old family cemeteries and one to replace an existing landscape wall. These walls are estimated to be 1-3 feet high and are illustrated in **Figure 3 Detail A**.





The curve between the Seaworthy Gallery and the Lee Robison General Store has frequent street flooding/drainage issues. Often ¹/₂ to 1 whole travel lane is under water (as seen in the photo to the left). This study proposes that the roadway grade be adjusted to improve the roadway drainage conditions (see also **Figure 6**). Installation of the curb-and-gutter drainage system will ease the problem as well.

Two existing drainage pipes extend outside existing NCDOT R/W in Section A (one that extends to the Marina). There are no current agreements or easements for the DOT to maintain these pipes. Costs for permanent drainage easements and replacing pipes have been included.



Parallel parking is proposed in front of the Wings Store and Sonny's Waterfront Restaurant. There are approximately 15 existing perpendicular parking spaces right off the roadway (see photo at right). Sonny's has a side parking lot as well. Approximately 8 parallel spaces could be provided (as shown on **Figure 7**). Unsafe backing maneuvers



onto NC 12 from the perpendicular spaces would be eliminated.

Approximately 25 parallel parking spaces can be provided from west of Midgett Realty (station 48+50) to the Kohler Road intersection. These can help define the village center and promote touring and shopping.

The following costs have been determined based on **Section A** improvements:

Section A Cost	\$ 4,550,000.00
Right-of-Way	\$ 1,375,000.00
Construction	\$ 3,175,000.00

It is anticipated that **Section A** will affect 61 tax parcels and require no relocations.

Section B includes the NC 12/Kohler Road intersection area (less than 0.1 mile) in the heart of the village. Numerous community places are located here; including the Community Center, Library, Post Office, Fire Station, Burrus Supermarket, ECB Bank and more. The studied alternatives in Section B build upon the Committee's prior work, aim to more clearly define the village center and provide safe routes for all users.

Optional designs are provided in Section B and shown on **Figure 7**. **Section B Option 1** proposes constructing a roundabout intersection with curb-and-gutter and sidewalks. **Section B Option 2** matches the current intersection configuration with added curb-and-gutter and sidewalks. Both options maintain emergency vehicle access. The 100-foot inscribed diameter roundabout accommodates fire trucks, school buses and single-unit trucks. The truck apron allows for the occasional WB-50 tractor-trailers. Both options more clearly define crosswalks, travel lanes and parking lots.

Intersection Traffic Analysis: A traffic analysis is provided for the Kohler Road intersection options. The traffic analysis was based on the Highway Capacity Manual and NCDOT Analysis Guidelines. An intersection traffic count was taken on July 25th, 2011. Based on historical data from NCDOT Traffic Surveys, an annual growth rate of 1.5% was used to project future year 2035 traffic volumes. Existing and Projected Traffic Volume Diagrams are shown on Figure 2.

Based on preliminary analysis, the **Section B Option 1** roundabout intersection, with a 100-foot inscribed diameter, is anticipated to operate at a LOS A through 2035. See **Table 2**. The overall intersection LOS is an average of the individual legs or approaches to the roundabout.

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TABLE 2 – ROUNDABOUT INTERSECTION – 2035 LEVELS OF SERVICE						
Approach	AM: Avg. Delay (sec.)	AM: LOS	AM: v/c ¹	PM: Avg. Delay (sec.)	PM: LOS	PM: v/c ¹
NC 12 (West)	6.3	А	0.20	8.4	А	0.29
Kohler Road (North)	6.5	А	0.09	5.8	А	0.10
NC 12 (East)	8.4	А	0.31	6.3	А	0.21
Intersection	7.4	A		7.2	A	

¹ IT IS NOT RECOMMENDED TO HAVE A v/c (VOLUME-TO-CAPACITY) RATIO HIGHER THAN 0.85.

No overall LOS are given for unsignalized intersections, and the reported LOS are limited to the minor street approaches. The Kohler Road approach to the unsignalized intersection is anticipated to operate at a LOS C in 2035, as seen in **Table 3**.

TABLE 3 – Stop-Controlled Intersection – 2035 Levels of Service					
Approach	AM: Avg. Delay (sec.)	AM: LOS	PM: Avg. Delay (sec.)	PM: LOS	
NC 12 (West)	n/a	n/a	n/a	n/a	
Kohler Road (North)	19.5	С	21.0	С	
NC 12 (East)	n/a	n/a	n/a	n/a	
Intersection	n/a	n/a	n/a	n/a	

n/a: Intersection LOS and Major Road Approach LOS values are Not Applicable to two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Therefore, based on this analysis, the stop-controlled intersection will likely operate at acceptable levels of service through 2035, and the roundabout at the best level of service. Additional investigations confirmed that the presence of fire trucks in the peak hours would not significantly affect the results shown above. These analyses are preliminary and should be examined in greater detail in the subsequent stages of the project.

Intersection and Parking Lot Designs: Operational and safety benefits can be experienced from the following parking lot design changes. These are important because of the close proximity of the parking lots to the intersection (as seen in the photo below). A one-way in, one-way out configuration was recommended by



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the Department and shown in the Stormwater Group Study roundabout concept. The Post Office/Community Center/Library parking lot currently has 14 perpendicular spaces (1 handicapped). Twelve (12) angled parking spaces (1 handicapped) can be provided with the proposed reconfiguration, the roadway widening, and a separator island. See Figure 7 Options 1 and 2.

The same one-way circulation concept has been applied to the supermarket parking lot. The existing parking lot has approximately 25 spaces (some unmarked). The reconfigured parking lot provides approximately 22 spaces with the roadway widening and a separator island.

The following costs have been determined based on **Section B** improvements:

Section B Option 2 Cost	\$ 650,000.00
Right-of-Way	\$ 175,000.00
Construction	\$ 475,000.00
It is anticipated that Section B Option 1 will affect 8 tax parcels and require no relocations.	
Section B Option 1 Cost.	\$ 750,000.00
Right-of-Way	\$ 225,000.00
Construction	\$ 525,000.00

It is anticipated that **Section B Option 2** will affect 8 tax parcels and require no relocations.

Section C includes the last 0.1 mile within the Hatteras village study area, from 250 feet east of Kohler Road to the eastern Slash Creek bridge (Bridge #8). The studied improvements include proposed roadway widening, curb-and-gutter, sidewalks, drainage systems, and on-street parking. Section C improvements provide as many as 21 parallel spaces; more than adequately compensating for the reduction in spaces at the Post Office and the supermarket. The additional parallel spaces and sidewalks also promote parking, walking, touring and shopping in the village.

The following costs have been determined based on **Section C** improvements:

Section C Cost	\$ 725,000.00
Right-of-Way	\$ 200,000.00
Construction	\$ 525,000.00

It is anticipated that **Section C** will affect 7 tax parcels and require no relocations.

E. STORMWATER QUALITY TREATMENT CONCEPTS

The team also prepared stormwater quality treatment concepts for Buxton and Hatteras villages. These are not included in the project cost estimates but should be considered (in total or in part) in the subsequent planning and design stages of the project. More information can be found in Appendix A – Stormwater Concepts. The Outer Banks Scenic Byway Committee enlisted a team of experts for the



NCDOT FEASIBILITY STUDY FS-1001A Page 12 of 15 purpose of generating <u>Stormwater and Water Quality Improvement Ideas</u> which were presented to the Committee in January 2011. The study group focused on Hatteras village and included ideas applicable to Buxton village. Recommendations and ideas from the "Stormwater Study Group" that can be implemented within the NC 12 right-of-way have been further developed in this study. Some strategies and ideas from the study are to: Reduce stormwater runoff, Improve water quality, Increase "green" area, Improve safety, and Improve aesthetics. Bioswale/Bioretention streetscape retrofits, on-street parking with permeable pavement, and Hatteras village roundabout concepts originated from the "Stormwater Study Group". The photo below shows a recent retrofit example at NCSU in Raleigh.

The proposed typical roadway section has a 4½-foot wide strip available for water quality treatment. **Details B and C** on **Figure 3** show two potential locations for bioswales/bioretention. Detail C has potential for larger treatment areas by expansion outside the R/W, such as shown



Bioswale Retrofit Example: Pullen Road Green Street Project. City of Raleigh ©2012

in the "Stormwater Group Study". However, Detail B is a standard NCDOT sidewalk location and works better with driveway connections. Either configuration works with the alternatives and costs in the study.

The following quantities extend through the whole village study areas. It is estimated that 20,100 square feet of green surface area is available for bioretention within the footprint of the Buxton roadway improvements at an approximate cost of \$ 460,000.00; and 24,600 square feet in Hatteras at a cost of \$ 685,000.00. This includes: estimated engineering costs; 9" concrete curbing at a cost of \$ 20.00/linear foot; and Excavation, Soil Amendment/Sand, Mulch, Plants, Plant Installation, Underdrain, and Underdrain Installation at a cost of approximately \$ 4.50/sf (based on Stormwater BMP Costs, Hathaway and Hunt, NCSU Department of Bio. and Ag. Engineering, Stormwater Engineering Group, 2007). Costs for the stormwater quality treatments are not included in the recommended alternatives. Their cost effectiveness and capability to treat enough volume of runoff need further investigation in the subsequent planning and design phases.

F. STREET LIGHTING

The Committee requested estimated costs for street lighting. There are a wide variety of types and costs for street lighting. **Figure 8** shows some example streetscape lighting on previous RK&K projects. Lump Sum costs shown in **Table 4** reflect wiring, poles, fixtures, engineering and installation:

TABLE 4 – STREET LIGHTING			
BUXTON	LUMP SUM COST	HATTERAS	LUMP SUM COST
Section A	\$ 8,000.00	Section A	\$ 127,000.00
Section B	\$ 37,000.00	Section B	\$ 16,000.00
Section C	\$ 16,000.00	Section C	\$ 16,000.00
Section D	\$ 31,000.00		
Total	\$ 92,000.00	Total	\$ 159,000.00

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It is estimated that street lighting for the Buxton village study area will cost an additional \$ 92,000.00; and \$ 159,000.00 for the Hatteras village study area. No proposed lighting was included on the south side of NC 12 from Buxton Back Road to Lighthouse Road. These costs are not included in the recommended alternatives and need further investigation during later planning and design phases.

VI - RECOMMENDATIONS

It is recommended that NC 12 be resurfaced and widened to two 15-foot travel lanes with 2½-foot curb-and-gutter and 5-foot concrete sidewalks on 10-foot berms. It is recommended that the existing roadway drainage systems be replaced in conjunction with the roadway improvements. The improvements are to be constructed within existing right-of-way, temporary construction easements and permanent drainage easements. The use of temporary construction easements reduces the permanent impact to village properties.

It is recommended that the Buxton Section A Option 2 – left-turn lane onto Buxton Back Road and Section C Option 2 - NC 12 widening in front of Dillon's Corner be included with the proposed typical section widening improvements in Sections B and D. The recommended roadway improvements include 5 short retaining walls to protect existing buildings/yards in Sections A and B. The Buxton Back Road left-turn lane option (Section A Option 2) is likely to improve traffic operations and safety. Further investigation in the subsequent project phases will provide better data on the need for the left-turn lane. The added cost for the left-turn lane onto Buxton Back Road is an estimated \$ 250,000.00 and 2,800 sf of R/W and construction easement. While Option 2 impacts Dillon's Corner store parking, it provides a consistent roadway section through the village and promotes safety and mobility. The elimination of backing maneuvers onto NC 12 from perpendicular parking spaces improves safety as well. This study recommends Section C Option 2, or some similar variation. There is room to relocate about 12 of the original 19 parking spaces. One-way traffic flow and angled spaces are also recommended for Dillon's Corner store parking. The off-the-road pathway connection to Fessenden Recreation Center could be added to Option 2 during later planning and design phases if desired. The total estimated costs, not including bioretention/bioswale or lighting, for the Buxton studied alternatives range from \$ 3,975,000.00 to \$ 4,250,000.00.

It is recommended that the Hatteras **Section B Option 1** – Kohler Road roundabout intersection be included with the proposed typical section widening improvements in **Sections A and C**. The recommended Section A alternative includes the typical section improvements described above, 3 short retaining walls (two for cemeteries), and a short section of on-street parking in front of the Wings store and Sonny's restaurant. On-street parallel parking is also recommended in the central district of Hatteras village (Sections B an C). In Section B this study recommends constructing the Option 1 roundabout, based on the OBX Byway Committee's plans, community input and the enclosed preliminary traffic analysis. Although the added cost for the roundabout option is an estimated \$100,000.00 and 2,500 sf of R/W, roundabouts reduce accident frequency and severity, reduce emissions and provide almost continuous traffic flow. The roundabout also provides a village gateway feature with an area for

NCDOT FEASIBILITY STUDY FS-1001A Page 14 of 15



small plants and the Hatteras flagpole. It is also recommended to reconfigure the post office/library/community center and supermarket parking lots into one-way circular flow, thereby improving traffic safety and mobility through the Kohler Road intersection. The total estimated costs, not including bioretention/bioswale or lighting, for the Hatteras studied alternatives range from \$ 5,925,000.00 to \$ 6,025,000.00.

VII - ADDITIONAL COMMENTS

- Consider adding one or more additional crosswalks in Buxton at station 40+50, Buxton Back Rd., and/or Lighthouse Rd.
- The NCSU Department of Biological and Agricultural Engineering, Stormwater Engineering Group is a valuable resource for water quality treatments including permeable pavement and bioretention. <u>http://www.bae.ncsu.edu/stormwater/</u>
- Other pathway projects are underway in the northern Hatteras Island villages and may have useful information for the planning and design of the FS-1001A improvements (i.e. TIP S-5104).

A. RED-FLAG ISSUES

These issues should be examined more closely in the subsequent planning and design stages of the project:

- Buxton: Dillon's Corner/pedestrian paths.
- Buxton: Red Drum property drainage.
- Buxton: Oramar Drive flooding/sand-washing.
- Buxton & Hatteras: On-street parking locations.
- Buxton & Hatteras: Roadside parking lots.
- Hatteras: Tide Gate/Check Valve locations.
- Stormwater Quality Treatment.
- Permeable pavement for on-street parking.

B. OTHER

• This Roundabout in Rutherford, NJ is a project listed on the FHWA's Context Sensitive Solutions website and, although more urban in nature, has similar features to the Hatteras village concept.













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	Proposed Sidewalk		
	Proposed Roadway		
	Proposed Roadway to be Resurfac		
	Proposed Grass Island		
	Proposed Wheelchair/Curb Ramp		
/	Proposed Construction Easement		
	Proposed Permanent Easement		
	Existing ROW		
	Proposed Retaining Wall		
R	Proposed ROW		
<u> </u>	Proposed Slopestakes		
are	County - SW Features		
	Inlet		
	SW Culvert & Pipe		
	Buxton Water Pipes		
	USGS Streams		
	Parcel boundaries		
	NWI Wetlands (Open Water Remov		
ommunity Facilities			
ŧ.	Cemetery		
t I	Church		
H)	Historical Structure		
	Hospital		
	Library		
	Note: The Dare County GIS Department supp parcel boundaries, and existing stormwater.		



FEASIBILITY STUDY CONCEPTS

BUXTON STORMWATER AND SIDEWALK IMPROVEMENTS On NC 12 Through Village DARE COUNTY

PREPARED FOR: PROGRAM DEVELOPMENT BRANCH N.C. DEPT OF TRANSPORTATION RALEIGH, NORTH CAROLINA W W W. n c d o t. o r g



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FEASIBILITY STUDY CONCEPTS

BUXTON STORMWATER AND SIDEWALK IMPROVEMENTS On NC 12 Through Village DARE COUNTY

PREPARED FOR: PROGRAM DEVELOPMENT BRANCH N.C. DEPT OF TRANSPORTATION RALEIGH, NORTH CAROLINA www.ncdot.org



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RALEIGH, NORTH CAROLIN. www.rkk.com









NOTE: THESE CONCEPTS ARE PRELIMINARY AND ARE SUBJECT TO CHANGE. THIS IS NOT THE PRODUCT OF EXHAUSTIVE ENVIRONMENTAL OR DESIGN INVESTIGATIONS.



PREPARED FOR: PROGRAM DEVELOPMENT BRANCH N.C. DEPT OF TRANSPORTATION RALEIGH, NORTH CAROLINA w w w . n c d o t . o r g



RALEIGH, NORTH CAROLIN w w w . r k k . c o m

PREPARED BY:



STREETSCAPE/LIGHTING EXAMPLES

FIGURE 8

FOR NCDOT FEASIBILITY STUDY FS-1001A



Background

Introduction

As part of the NCDOT Feasibility Study FS-1001A, RK&K has been asked to make conceptual level recommendations for improvements to the stormwater system in Buxton and Hatteras as part of the feasibility study to: 1) improve the roadway section to better accommodate bike transportation, 2) provide 5ft sidewalks, and 3) to provide curb and gutter along the improved roadway section. The typical section for the improved roadway stays within the current R/W of 60ft and includes the sidewalk located immediately adjacent to the curb and gutter and a 4.5 ft grassed area on the outer side of the sidewalk. The impervious area within the typical roadway section increases from 22 ft in width to a total of 45 ft of directly connected impervious area, Section 1 below. Section 2, which includes parallel parking accommodations increases the impervious area of the typical roadway section to a total of 53 ft of directly connected impervious area.



Scope of Analysis

The Stormwater analysis component of the NC-12 Improvements Feasibility Study included the following tasks: 1) Evaluate current storm drain system with the goal of reducing street flooding 2) Recommend improvements for localized flooding issues, 3) Evaluate opportunities for stormwater quality treatment of the roadway runoff.

Conceptual Stormwater Design Development

To begin conceptual stormwater design for the project, several sources of data were gathered and reviewed. GIS data supplemented with field survey of existing stormwater systems largely facilitated the stormwater analysis. The field survey data was limited in locations as structures and pipes were filled with water/sediment. Drainage basins were delineated in GIS using 2007 and 2010 aerial photography, 0.5 ft contours (generated from NCDOT LiDAR Data Download) and GIS stormwater inventory data provided by Dare County. Basin delineation in such a low relief area is difficult and requires significant engineering judgment based on available data. It is recommended that the basin delineation be field verified and refined as the project is further developed for engineering design.

Peak flows were developed using the Rational Method for both the pre-development and postdevelopment conditions. Design rainfall intensities were taken from NOAA data using the Hatteras gage location [Latitude: 35.2322, Longitude: -75.6225, (decimal degrees)]. Selected trunkline systems were evaluated for hydraulic capacity using the 10-yr design storm. Time of concentration was developed along the longest flow path and was determined using the Kirpich equation and engineering judgment. Where available, field survey data was used to establish pipe inverts. Pipe inverts where no invert survey data was available were interpolated between other known inverts or otherwise pipes were assumed to have a 0.5% slope. A backwater elevation of 2.5 was used to set the downstream condition for the 10-yr design storm. Hydraulic grade lines for the existing system and conceptual proposed system were evaluated in StormCAD®V8i.

Conceptual Stormwater Recommendations

General Stormwater Recommendations

1. Elliptical Pipe

Consider storm system designs that include elliptical pipe. Elliptical pipe offers more waterway flow area than "equivalent" circular pipes. In addition, elliptical pipes require shallower trench depths due to the oblong shape as compared to traditional circular pipes and maximize available pipe slope. Trench depth is an important parameter in low lying areas, like the coast, with minimal vertical elevation relief to allow gravity flow.



2. Tide Gates/Check Valves

Tide gates/check valves can be instrumental in reducing tide effects within the storm drain system. In addition to the traditional metal flap gates, it is recommended that newer technology, such as the TideFlex duckbill check valve, be considered. These products are constructed of 100% elastomer and are said to be maintenance free. The manufacturer indicates that the valves will not corrode, warp or freeze open or shut. In researching the use of these products, it was found the City of Wilmington, NC has several of these devices in use. The stormwater maintenance manager, Mr. Harvey London, indicated that his experience with this type of product has been positive and better than that of the traditional metal tide gates that get stuck open or wedged closed with debris. He said that the Tide Flex valves tend to be less maintenance intensive than traditional gate valves.





3. Parallel Pipe Systems

Parallel pipes systems can be instrumental when additional flow capacity is needed in areas where vertical restrictions preclude the use of larger pipe. It is recommended that parallel pipe systems be considered to provide additional conveyance capacity.

4. Concrete Pipe

The field survey data and GIS data indicated the widespread use of Corrugated Metal Pipe (CMP). While CMP has its advantages, the use of concrete pipe increases the hydraulic conveyance of a pipe system as it offers less friction to flow due to its smooth interior. In addition, concrete pipe is more durable and resistant to corrosion.

4. Routine Maintenance Cleanouts.

Routine maintenance is critical for sustained stormwater system performance. It is recommended that routine maintenance programs in Buxton and Hatteras be reviewed. Routine maintenance should address open drainage, closed pipe system, and BMP maintenance needs. To better inform the recommendations made in this section, the City of Wilmington staff was contacted. During this phone interview, stormwater maintenance staff was asked about routine maintenance practices and common maintenance issues encountered. *Pictures included in this section were taken from City of Wilmington, NC website.*

At minimum, it is recommended that inspection and maintenance actions be taken on closed pipe systems at least once per year, or more as dictated by need. Maintenance inspections should also be prioritized for higher need areas before large storms occur to ensure proper storm drain function. Inspections from the ground surface can be facilitated with pole cameras, surface inspection with probes, and other methods. Vacuuming of storm pipes is important to maintain flow capacity of the stormwater system.

It is recommended that open channel drainage systems be mowed, ditches cleaned of sediment/debris (non-jurisdictional drainage only), monitored for nuisance aquatic weed growth and monitored for erosion control needs regularly. It is advised that maintenance staff be aware of sensitive jurisdiction waters and allowable maintenance practices. It is recommended that sediment removal from ditches be evaluated annually, or more frequently as needed. It is recommended that mowing occur a minimum of twice annually.





Stormwater BMPs also require routine annual inspection. Inspection should include evaluation of the BMP for erosion, sediment deposition, monitored for plant overgrowth/undergrowth, monitored for invasive nuisance aquatic weed growth, etc. Stormwater BMPs that rely on infiltration (i.e. sand filters, bioretention areas) should be observed after significant rainfall events (>1.5" rainfall) to observe infiltration rates. Typically BMPs should drain completely in 2-5 days. BMPs not meeting this infiltration

criterion should be investigated further by Engineering staff.

Adding curb and gutter to the roadway section may increase the need for street vacuuming as there is more opportunity for sand and sediment to accumulate in the curb line. In addition, curb cuts to facilitate roadway drainage can become clogged as the flow area for roadway drainage is smaller than typical drop inlets. The frequency of street sweeping recommended is variable with location. It is



Appendix A Page 3

recommended that street maintenance include evaluation of sand buildup on roadways and regular inspection of curb cuts and inlets for clogging. The City of Wilmington indicated that all curb and gutter roads are swept using the vacuum trucks. The downtown area (high traffic) is done 3 times a week, whereas residential areas area swept one time a month.

Stormwater Quality Treatment Opportunities

Implementing stormwater water quality treatment within the existing Right-of-Way limits of NC-12 using the improved roadway sections is challenging. Typical design criteria for new design projects requires that the runoff from the first 1.5" rainfall be treated. Based on the current typical proposed sections, water quality treatment opportunities will be limited within the 4.5 ft green space, see figure below. Because the footprint to implement stormwater quality is very limited within the existing NCDOT right-of-way, any water quality feature and its benefit will be to the maximum extent practicable given the challenges of implementing water quality features in this retrofit environment.

In areas where parallel parking is proposed, the designer should consider the use of permeable pavement for the parallel parking stall. As the design of permeable pavement is more fully developed, the designer should evaluate the suitability of the site that is considered for permeable pavement. Special attention should be given to the seasonal high water table elevation, estimated traffic volume counts, and how the overall site characteristics lend itself to permeable pavement (including the overall drainage area draining to the proposed permeable pavement application).



The OBX Scenic Byway <u>Stormwater and Water Quality Improvement Ideas</u> was reviewed for stormwater treatment concepts within the project limits of the NC-12 Improvements in Buxton and Hatteras Feasibility Study. While the presentation included stormwater treatment options for a range of site locations, for the purposes of this report the focus for stormwater treatment concepts will be limited to

those that can be implemented within the existing Right-of-Way of NC-12.

Bioswales:

Given the limited footprint within the right-of-way for NC-12, the use of BioSwales is the BMP with the best opportunity to provide water quality treatment for runoff from NC-12. In the roadway environment, bioswales offer a great opportunity to provide water quality as they can be implemented in the footprint of the traditional roadside ditch. As shown in the OBX Scenic Byway presentation, the



footprint of bioswales can be adapted to accommodate retrofit locations. The following picture (taken from the OBX Scenic Byways presentation) demonstrates the bioswale concept most likely to work best within the area available for stormwater quality treatment along NC-12.



Figure 1. Adapted from the OBC Scenic Byway presentation.

The example is much like the concept that could work within the NC-12 proposed typical section. The concept for NC-12 features:

- Curb cuts with metal hoods,
- Raised curb bioswale border for pedestrian/bike safety,
- Planted bioswales using native vegetation species.
- Raised grates to provide an overflow system when the available volume in the bioswale is utilized within each bioswale cell. The overflow grate inlet will be connected to the storm drain system potentially located in the existing stormwater pipe alignment.

The NCDENR Stormwater BMP Manual provides guidance for the design of bioretention facilities, see figure below. Bioswales should be designed as an adaptation of the bioretention. However, to fit inside the typical roadway cross section and within the elevation constraints, the criteria will need to be adapted based on local conditions. For example, the design criteria may need to be adapted as follows:

- the maximum ponding depth may need to be reduced to 6" or less given the elevation constraints,
- media depth should be evaluated
- separation between the bioswale invert and the Seasonal High Water Table (SHWT) should be evaluated.
- No underdrains will be necessary.

Because of the space and elevation constraints, the bioswales that could be integrated into the typical sections proposed will likely not be adequate to treat the required volume (runoff from the 1.5" rainfall). Therefore, a cost-benefit analysis should be completed during the design phase to better understand the cost effectiveness of implementing the bioswales. The elevations in Buxton overall are

about 2-3 ft higher than as compared to Hatteras. Therefore, implementation in Buxton will likely be more feasible than in Hatteras.



Figure 2. Typical bioretention cross section taken from the NCDENR Stormwater BMP manual.