IMPLEMENTATION, MONITORING, AND PLAN REVISION

6.1 OVERVIEW

Previous chapters focused on public stewardship and general descriptions of available management and restoration measures. This chapter lays out concrete steps for the two Towns to undertake for turning the vision of restoring the aquatic health of Bolin Creek into a reality.

As the first step in implementation, the Towns of Chapel Hill and Carrboro are being asked to adopt this Plan. Through adoption of this document as the official plan, the community is better able to shape decisions so that they fit with the goals of this plan. Adoption of this plan also will help shape future development and redevelopment so that the resulting built form achieves the goals and vision of this plan. Importantly, adoption is key to securing funding from state and federal agencies in support of implementing the recommendations of this plan.

The implementation process listed below encompasses a mixture of both broad and specific early strategies that are recommended for stewardship, retrofits and restoration projects, funding, responsible parties and roles, and a time frame. Following these implementation steps will provide structure to the entire effort, avoid pitfalls experienced in earlier retrofit efforts, and should help ensure that watershed restoration is progressing on track. These details will make it easier to identify problem areas and update this plan.

Watershed Restoration has already begun in the form of public outreach, involvement, and actions individuals can take as described in the Watershed Stewardship chapter. The Stewardship effort is an essential part of implementation, since understanding and support from the public will be essential to more capital-intensive implementation.However, as recommended in prior studies, stormwater retrofits and stream restorations targeted directly in the most intensely-developed parts of the two towns will be necessary to the restoration of Bolin Creek's biological health.

6.2 CARRBORO RESTORATION PRIORITIES AND IMPLEMENTATION

In Carrboro, the most heavily-developed, and oldest, part of Town in the Bolin Creek watershed drains to Tanbark Branch and an adjacent unnamed tributary (which has been named Shetley Branch) as part of developing this plan. Biological sampling associated with a recent restoration project at Baldwin Park shows that Tanbark Branch has Poor biological integrity. This part of the watershed within Carrboro: is at highest risk for illicit discharges and sites of groundwater contamination; has stream impacted by piping, channelization, or other direct and indirect modifications; has minimal stormwater controls and extensively-cleared riparian zones; and demonstrates compromised geomorphic conditions. In association with the more intensive development, these tributaries in Carrboro have the highest degree of impairment, and are "exporting" some of their problems downstream to Bolin Creek in the form of flashy flows, heavy sediment loads, high stormwater temperatures, and chemical pollution.

Similar studies as have been done on Tanyard Branch and Mill Race have not been completed for these tributaries. Carrboro staff have therefore not had the opportunity to determine the best strategy for moving forward with implementation, beyond these observations:

1) There is a stream daylighting/restoration opportunity at the headwaters of Tanbark Branch that warrants further study
2) The Town has already committed in its Capital Improvements Program to complete a significant stormwater/restoration project adjacent to Carrboro Elementary School at the headwaters of Shetley Branch
3) Prioritizing these watersheds for municipally led efforts would compliment efforts in Chapel Hill described above and result in the highest likelihood of improvements to Bolin Creek.

Carrboro also is home to the headwaters of Bolin Creek, the section of the watershed facing the most development pressure. It is critical for Carrboro to protect the headwaters from new impacts as this area continues to develop. By the nature of land use patterns in Carrboro, it is also essential that watershed restoration efforts have a strong distributed, residential focus with broad participation.

6.3 CHAPEL HILL RESTORATION PRIORITIES AND IMPLEMENTATION

In Chapel Hill, the most heavily-developed, and oldest, parts of Town drain to Tanyard Branch and Mill Race. Biological sampling in 2011 and 2012 shows that both of these tributaries show Poor biological integrity. Based on staff experience, both tributaries are exposed to illicit discharges and sites of groundwater contamination; have considerable lengths of stream impacted by piping, channelization, or other direct and indirect modifications; have no stormwater controls installed throughout the drainage area; have extensively-cleared riparian zones; and demonstrate some of the worst geomorphic conditions. Quite simply, of all the Bolin Creek tributaries in Chapel Hill, these have by far the worst conditions. There is no doubt these two tributaries are "exporting" some of their problems downstream to Bolin Creek in the form of flashy flows, heavy sediment loads, high stormwater temperatures, and considerable chemical pollution.

One watershed restoration approach would be to install stormwater structures where we find willing property owners. While this approach acclimates residents and property owners to modern methods of lot-level stormwater management, it's quite likely these volunteers will not be located in the two watersheds most in need of stormwater retrofit of existing development. Furthermore, Chapel Hill's staff have experienced the difficulty of trying to site a small stormwater management project that was targeted to address a specific problem. Town staff spent considerable time and effort in outreach to gain property owner support for a project that was not expected to improve conditions in Bolin Creek significantly. This is an inefficient use of staff time and resources.

Studies by NCSU staff have shown that in more densely-developed areas, there is a level at which there are greatly diminishing returns for installing stormwater structures to treat nutrients, such as for Jordan Lake retrofit projects. It has been found that the greatest stormwater treatment efficiency (cost for developed area treated) in these areas is provided by regional stormwater treatment facilities that treat a few hundred acres, rather than on widely distributed retrofits each treating only a few acres.

Therefore, to maximize the amount of stormwater improvement for the amount of staff time spent developing project concepts and gaining property owner cooperation, the Town has chosen to focus its efforts on regional stormwater retrofitting of these two tributary watersheds. As a Stormwater Alternatives Analysis for Tanyard Branch has shown, additional distributed stormwater

management would still be necessary in lower density portions of the watershed in order to adequately protect the stream from excessive erosion. But these projects can be pursued as part of the public-oriented Watershed Stewardship. In contrast, the complex process to install the required capital-intensive, regional stormwater management in these two tributary watersheds is laid out as a series of implementation steps and milestones as described in Appendix 7.

Implementation would start with detailed stream walk assessments to evaluate stream condition and to look for the small but significant sources of impairment that we suspect we are likely to find, along with other monitoring to get a "baseline" condition. Since we suspect that the primary stressors in these two watersheds are hydrologic changes (specifically, greater flashiness), poor geomorphic condition, poor riparian condition, and considerably-polluted urban runoff, it is likely that some sort of stormwater retention will be necessary to get the situation under control and allow for restoration of the streams where possible along their lengths. Our alternatives analysis for Tanyard Branch has already demonstrated that some amount of stormwater retention in a wet pond is necessary to allow downstream restoration projects to be protected from "blowout". Such a wet pond would also provide much-needed chemical treatment of stormwater runoff. We expect this is likely for Mill Race because it shares similar land uses, densities, ages of development, and geophysical characteristics.

After initial hydrologic monitoring is started, Town engineers can identify alternative management methods that would provide the needed amount of stormwater control to compare and contrast with each other. Working with this information, we will attempt to find multiple acceptable locations on each tributary for a wet retention pond and for alternative management methods for comparison. From there, cost estimates would include the cost for design, construction, and maintenance of the stormwater structures plus costs for land or easement acquisition (including legal and property assessor fees). We would also need to determine whether any utilities would need to be moved, costs for acquiring new utility easements, and costs for any permitting or additional studies that would need to be done.

Because we would be installing these structures with the expressed purpose of conducting successful, stable restoration projects downstream, and incidentally using these restoration areas as mitigation for the portions of perennial stream we would impact with construction of the wet ponds, identification of the potential restoration zone would need to be done with the assistance of the US Army Corps of Engineers. Ideally, we would identify the areas most in need of restoration and estimate the amount of functional uplift we could attain. Depending on adjacent land uses, we may need to come up with alternative restoration scenarios with different amounts of uplift and different project costs. Ideally, we would identify a sufficient segment of stream with adequate uplift potential to meet the mitigation needs for the wet pond impacts. From this point we would do cost estimations similar to those conducted for the stormwater management alternatives upstream of the restoration sites.

Given changing political attitudes of the general public and Town leaders, we feel an explicit monetary cost-benefit analysis is needed to gain the needed support for implementation. These estimates above would form the core of the *costs* of implementing watershed restorations. We would begin to calculate the *benefits* by evaluating the amount of Jordan Lake nutrient retrofit credits we could expect to get. Given we would be treating moderately large areas, with high land use intensities, using reasonably-high efficiency stormwater treatment, the amount of awardable credits could be a significant proportion of the total retrofit burden the Town carries. To get an

idea of the value of these credits, we would need to identify other potential retrofits around Town to determine how much it would cost to get a comparable number of retrofit credits in other parts of Town. This will admittedly require cost estimation for a considerable number of stormwater structures, as no other parts of Town have the same land use intensity and are therefore less likely to be able to provide the same amount of credits for the area treated. The difference in costs between downtown treatment and other parts of Town would be in ease of land or easement acquisition and cost of installation.

The second part of calculating benefits would require assistance from NC DWQ. Since it is very likely properly treating these two watersheds could pull sections or all of Bolin Creek off of the Impaired Waters list, we need to know what the monetary value is of doing that. This may be estimated by any fees or charges the Town may face if it does not ever restore the stream sufficiently to remove it from the Impaired Waters list. There are alternative ways of estimating the value of improving the stream's health based on various environmental economics methods of valuing natural resources, and we would request assistance from the Division of Water Quality to get these estimates.

We expect that this is the minimum amount of information that would be required to present to the Town Council, Town Manager, property owners, and general public to win support of this fairly complex pair of restoration projects. We also expect that we will need to do presentations of information gathered at every step. This may be facilitated by holding presentations in cooperation with Friends of Bolin Creek as part of a special symposium or event.

6.4 FINANCIAL AND TECHNICAL ASSISTANCE NEEDED

A premise of this plan is that the commitment is in place to secure the funding necessary to immediately begin the short-term phase work, and start working on a funding strategy that will allow the community to incrementally complete many of the recommendations over a 5-10 year period. Recommendations are most likely to be undertaken effectively if a reliable long-term source of funding is available. Possible sources include grants, stormwater utility fees, or other local government financing mechanisms. The Town of Chapel Hill has developed a stormwater utility that includes program elements to address water quality and quantity through a comprehensive stormwater and floodplain management program. The Town of Carrboro should pursue the development of a long-term funding strategy. Ideally, the Towns should have a budget line item in annual and capital improvement budgets for restoration efforts in order to implement the top priority recommendations. It is also recommended that each Town establish a Bolin Creek restoration fund and use it to pursue municipal projects. Meanwhile, Town staff will continue to pursue state/federal funding support through grants.

Chapel Hill has staff certified for doing civil engineering studies and designs, staff certified/experienced in: environmental outreach and education; project management and planning; mapping and GPS/GIS; surveying;, and environmental assessment and monitoring of many kinds. Their skills cover engineering concept designs, calculation of Jordan nutrient credits, identification of potential retrofit sites, broad public outreach and involvement, and various data collection, monitoring methods, and tasks. Provided these staff are still available during the implementation period, technical assistance is only likely to be required at the points of formal engineering design, assessment/valuation of property or easements, acquisition of property or easements, formal alternatives analysis (for Mill Race only), macroinvertebrate identification,

laboratory sample analysis, ecosystem services valuation, and construction of stormwater retrofits, stream restorations, and utility moves. Some technical assistance in the form of review, addressing fine details, or "second opinions" may be needed at many points along the implementation process. We believe NCSU's Water Quality Group/Bio & Ag Engineering staff, NC Cooperative Extension, and NC DWQ staff can provide the needed expertise and advice in these cases.

For Chapel Hill, the greater restriction on progress will be the cost of implementation. As Appendix 7 makes clear, even an estimate of costs for a full combination BMP retrofit and stream restoration and associated maintenance are not currently known. However, the Alternatives Analysis for installing a stormwater wet pond at the head of Tanyard Branch estimated approximately $510,000 in capital costs alone to install an "undersized" pond. The most efficient combination of stormwater management that still adequately protected downstream restoration included this pond in addition to extensive retrofits on UNC property and residential areas with capital costs totaling more than $4 million. But these values may be seen as a lower bound on costs for stormwater management in Tanyard Branch, and thus indicates the magnitude of costs Chapel Hill may face in implementation.

Carrboro does not currently have a stormwater utility and by association, the breadth and depth of staff skills and experience as in Chapel Hill. Currently, the Environmental Planner has extensive watershed management experience, but this position is able to dedicate limited time to restoration efforts. Carrboro works with a contract engineering firm, however, this firm to date has not been tasked with supporting watershed restoration efforts. Carrboro therefore has greater technical assistance and capacity building needs than in Chapel Hill to include, but not necessarily be limited to, civil engineering studies and designs, environmental outreach and education, mapping and GPS/GIS, surveying, and environmental assessment and monitoring of many kinds, (macroinvertebrate identification, field and laboratory sample analysis), ecosystem services valuation, and construction of stormwater retrofits, stream restorations, and utility moves. Carrboro also faces a significant hurdle with the cost of implementation, amplified by the absence of a revenue stream through a stormwater utility. The cost that Carrboro may face has not been quantified in this plan, but given the analysis done for Tanyard Branch, estimated costs for Jordan Lake compliance, and experience in other jurisdictions, it is clear that the costs will be significant and will require extensive technical and policy study to estimate and review.

Implementation also includes the extensive public outreach and involvement described in the Watershed Stewardship chapter. Extensive time will be required to produce outreach materials and organize and run events, and it is uncertain whether either Town will have much staff time to devote to this. Outreach materials for Chapel Hill's current 319 grant have run close to $2000, for just a small set of projects. More complex projects will require much more extensive outreach.

The costs of monitoring general watershed conditions and in support of preparing and installing restoration designs can be more easily estimated. The USGS stream gage on Bolin Creek costs $15,000 annually for maintenance (as quoted by USGS). Macroinvertebrate monitoring in both the two Towns combined runs at about $15,000 annually as well (summarized by 2012 collection costs for the entire area, for Bolin only these costs are closer to $8,000). Planned water chemistry monitoring at fairly high frequencies, but at a limited number of sites, may run from $8,000 to $15,000 depending on the number of constituents analyzed. This estimate is based on the cost of water chemistry monitoring conducted from 1994 to 2009, which had a similar number of annual samples collected less frequently at many more sites. Fortunately, Chapel Hill has equipment to conduct continuous water level and temperature monitoring at two small stream sites, using the

ISCO stormwater samplers that were acquired as part of the current 319 grant. (Carrboro does not have similarequipment). Other data collection will use minimal equipment or supplies, and rely primarily on staff time and experience. It may be assumed that combined annual monitoring costs (limited to Bolin Creek watershed) will run between $32,000 and $40,000 annually for the two Towns combined.

6.5 RESPONSIBLE PARTIES, STAKEHOLDERS, AND ROLES

An important goal of this plan is clarity in assignment of responsibility for different aspects of the implementation. The implementation steps described above are specific to the two Towns, and they will have primary responsibility for pursuing these projects because of their complex, capital-intensive nature. But these are just a portion of what will be required to restore Bolin Creek's biological health.

Our streams suffer from a cumulative "death by a thousand cuts" – from many seemingly harmless actions that add up to a large harmful effect. Environmental laws in the past 40 years have dramatically reduced the "big sources" – the singular and intense disruptions of ecosystem function that once happened with great media attention. However, these environmental protection efforts have only slowed the worsening of degradation when it comes to urban stream stressors, not reverse it. Furthermore, our system of laws, being focused on big actions that have demonstrably bad effects, cannot deal adequately with common actions that have infinitesimally small, but still negative, environmental effects. It is difficult to demonstrate to anyone that any particular small action is part of a pattern that causes a significant problem.

Given the distributed, non-point-source nature of impairment in the Bolin Creek Watershed, restoration measures must necessarily be distributed to some degree. The Watershed Stewardship chapter describes many actions individual property owners can take to contribute to watershed restoration. However, small, individual actions that aim to repair the damage from millions of other individual actions may not give a person much gratification, or the feeling that their actions matter. Small, singular projects may appear to have negligible improvement on downstream areas. While individual actions may seem like they make no difference, the difference is evident when many people take such actions. The difference *starts* when individuals demonstrate to others alternative attitudes and behaviors, sharing these with many others. Therefore, it is important for individuals to understand they are very much part of the solution, no matter how small their actions may seem. One of our most important management measures is continual outreach to the public to emphasize that their small contributions are in fact very valuable. Our message must be "Every little bit counts!"

Whether the projects are complex capital improvement projects spearheaded by the Towns, or individual, lot-level, volunteer efforts, the success in pursuing measurable goals at any scale will be in large part a factor of the degree to which private residential landowners can understand and participate and cooperate in the implementation of the plan. This is because most of each Town is in residential development, and areas owned by institutional, commercial, and governmental entities are much smaller (with the exception of UNC's Carolina North property). Institutional and commercial sectors also need to be active and important as the plan is pursued; however, the reality of land use within Bolin Creek lends credence to the idea that ultimately the fate of Bolin Creek is most intimately tied with behaviors and values of the homeowners who reside in the

watershed. It is the intent of this plan to support all watershed residents, but especially homeowners, in practices that help restore Bolin Creek and its tributaries.

Many other restoration projects may be implemented by a variety of stakeholders, such as those listed in Appendix 2, with more extensive source types and actions listed in Appendix 4. The Situation Assessment conducted by WECO, as described in the Watershed Stewardship chapter, highlights the great number of stakeholders and their interests. With so many actors, it will be easy for projects to conflict or be lacking in cooperation or coordination. One of the primary recommendations from the Situation Assessment was the creation of a Watershed Restoration Coordinator to bring together the many stakeholders and their interests in a neutral setting, to help coordinate their actions, and maintain a focused implementation of the Watershed Restoration Plan.

An important implementation objective is to insure that watershed planning is integrated with other planning efforts in the community including long-range and current land use planning, economic development planning, and environmental planning. An additional objective is to create the necessary administration capability to oversee the implementation of this plan and the proper maintenance of the restoration practices that are developed. Since Bolin Creek crosses a joint planning and two municipal boundaries, it is important to coordinate efforts to develop a restoration program and projects across administrative boundaries. We believe a Watershed Restoration Coordinator would be in the best position to achieve these objectives.

Because of their intense interest in the restoration of Bolin Creek, and watershed orientation, one possibility is for the two Towns to hire a consultant to act as a Watershed Restoration coordinator, or for the Friends of Bolin Creek to work with the Bolin Creek Watershed Restoration Team and others to create and fund this position. This person would handle the day-to-day implementation of recommended outreach activities described within this plan. Other responsibilities could include working with the BCWRT to periodically update this plan, serving on local advisory boards. This position could initially be part time in nature but may become full time as dictated by workload. The Coordinator could lead efforts to apply for funding, oversee planning, mapping, and design and development of homeowner/neighborhood/business scale projects and programs. The Coordinator should assist the BCWRT with programming, public outreach, and policy development. This new position is necessary given the existing responsibilities of the Towns' staff and the additional responsibilities that would come with implementing this Plan, as well as the other duties as described above. The Coordinator should report to the Bolin Creek Watershed Restoration Team on a regular basis.

6.6 PLAN EVALUATION AND REVISION

This Restoration Plan should be updated periodically and completely updated within the next 5-10 years. Annual reports of restoration activities, including and especially public outreach and involvement activities, and progress along the implementation steps should be attached as an addendum to the existing Plan. It will be the responsibility of the Bolin Creek Watershed Restoration Team in cooperation with interested stakeholders, or the Watershed Restoration Coordinator if that position is funded, to evaluate and monitor the implementation of this Plan. The BCWRT should use the evaluation and review process to evolve and adapt as needed. Land use, transportation, development, the economy, and the overall landscape will continue to change as

Bolin Creek changes. Also, new opportunities or input from an on-going monitoring and evaluation process may emerge, leading to the need to adapt and update the recommendations of this Plan.

Implementation progress can be compared for Chapel Hill against their proposed implementation steps and milestones as shown in Appendix 7. As a formal way to ensure plan evaluation, several "decision points" are noted in Chapel Hill's implementation steps. These are points at which the management approach and implementation steps should be evaluated carefully. If the presented management approach or implementation steps need extensive modification, are infeasible, or are inadequate to address the problem of Bolin Creek impairment, these are the points at which a new management approach or implementation steps would be determined. In this event, the Watershed Restoration Plan would experience a major revision. Small adjustments do not require a revision of the Watershed Restoration Plan, although an addendum should be added with a revised series of steps or milestones as appropriate.

6.7 MONITORING AND EVALUATION OF RESULTS OF PLAN IMPLEMENTATION

Macroinvertebrate monitoring has been used to rate Bolin Creek as impaired, and the Towns have conducted additional macroinvertebrate monitoring on the Bolin Creek main stem and its tributaries to try to better understand the sources of impairment as well as to gauge the highest priority tributaries for restoration efforts. Because the sources of impairment are multifold, we believe continuing annual macroinvertebrate monitoring on Bolin Creek and its tributaries using NC DWQ methods is the best way to evaluate progress towards the overall goal of getting Bolin Creek off of the list of impaired waterbodies. Since our management measures and implementation are being targeted towards specific tributaries, macroinvertebrate monitoring on other tributaries will tell us whether we are maintaining water quality standards or whether we have unaccounted-for stressors and sources in these tributary subwatersheds. Should we have negative changes in these tributaries, this will be an indication we need to revisit management measures, our priorities, and implementation.

Since stressor types and sources are so broad and variable in this watershed, we don't believe monitoring other aspects of stream condition will be useful to evaluating progress towards the goal of restoring Bolin Creek's biological health. However, other monitoring will allow us to watch for progress or any other changes to some degree, as well as identify finer-scale stressors and sources for targeted projects. Experience has shown us that sources can be very concentrated indeed, and easy to miss with larger GIS-based or watershed-scale assessments. In cooperation with the Ecosystem Enhancement Program and the US Geological Survey, a real-time stream discharge gage has been installed on Bolin Creek at Village Drive. This position was chosen as the closest practical gaging site to the Towns' mutual boundary, and a good point for monitoring water chemistry. Real-time monitoring (i.e. every 15 minutes) will help us understand Bolin Creek's hydrograph and response to storms, and allow us to detect whether any projects in Carrboro are having a noticeable effect on Bolin Creek's hydrograph.

The Town of Chapel Hill expects to do more targeted assessment and analysis of conditions in the Tanyard Branch and Mill Race tributary subwatersheds as these two tributaries have the highest priority for restoration projects, but also have the most complex combinations of stressors and sources. As shown in Appendix 7, we expect to conduct more detailed stream walks including assessment of habitat condition, culvert condition and fish barriers, geomorphic condition and stability, riparian condition, locations of major and minor stormwater contributions, and

potentially water chemistry monitoring. While this monitoring is intended for the purpose of fully understanding the magnitude and type of stressors in each subwatershed, and designing appropriately to mitigate their effects, it can also be used to evaluate how well full implementation addresses the impairments of these two streams. Such monitoring would need to continue several years past the conclusion of construction to truly evaluate stable post-restoration conditions.

Monitoring results will be used to evaluate stability of conditions in the watershed as a whole, as well as to be vigilant for potential new stressor sources developing. Monitoring may lead to actions such as illicit discharge enforcement, emergency small capital improvements projects, low-tech stream stabilization or enhancement (such as live stake planting), and targeted public involvement and neighborhood projects. These activities should be reported as an annual addendum to the Plan, rather than a Plan revision. Should monitoring indicate a tributary other than Mill Race or Tanyard Branch is experiencing dramatic worsening, this would be a reason to consider a Watershed Restoration Plan revision. Other reasons for plan revision are described in the section above.