APPENDIX I

2005 Environmental Report

Executive Summary
City of Wildwood Master Plan Environmental Report
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Background

The Environmental Report written in 1995 for the first Master Plan identified urban stormwater runoff as the principal environmental threat to the City. Stormwater runoff caused rapid erosion of stream channels, primarily in the Caulks Creek Watershed. The Caulks Creek headwaters are south of State Route 100 near the Lake Chesterfield Subdivisions. The watershed drains to the north and includes most of the land east of State Route 109, including the Cities of Clarkson Valley and Chesterfield. Caulks Creek is the most damaged watershed because it sustained the majority of the rapid, unsustainable urbanization prior to the incorporation of Wildwood. The erosion-induced channel widening exposed sewer and water lines and threatened private and public infrastructure (roads and bridges). The collapse of the Kehrs Mill Bridge in the early 1990's was a result of channel erosion. Additionally, in the spring of 1996, a retaining wall in Shotwell Creek, adjacent to Valley Road, collapsed, after it was undermined by channel erosion.

The primary challenge associated with monitoring and prioritizing problems in the Caulks Creek Watershed was the extremely dynamic nature of fluvial systems, which, in Wildwood, are further exacerbated by the variabilities of local climatic, topography, and soil conditions. Several locations were identified in 1995 as sufficiently serious to warrant monitoring and long-term planning for remediation. Among these were:

a) The large cutbank adjacent to Strecker Road, north of the intersection with Clayton Road (referred to subsequently as the "Strecker Road cutbank"); and
b) The bridge and adjacent cutbank at McBride Pointe Drive and Strecker Road; and
c) The bridge at Strecker and Valley Roads; and
d) The bridge and adjacent cutbanks at Shepard Road and Strecker Road; and
e) The bridge and adjacent cutbank at Church and Strecker Roads; and
f) Those portions of Valley Road adjacent to Shotwell Creek.

Realization of the long-term economic problems associated with stormwater-induced stream channel erosion and the related infrastructure damage and property loss produced the awareness that steps must be taken to minimize urbanization-induced runoff in the City's eight (8) other watersheds. Consequently, a soil-landform based zoning matrix (Natural Resource Protection Standards Matrix located in the City's Subdivision and Development Regulations) was established and interlinked with tree and grading ordinances. The intention was to restrict urbanization to locations and densities that would minimize stormwater runoff problems and to leave sufficient native forest cover to protect steep slopes and ephemeral drainage ways.

<u>Results of the Environmental Matrix</u>

The environmental, tree, and grading ordinances have accomplished the intended result. Several subdivisions constructed under the guidelines of these ordinances have been observed. Stormwater runoff has had little impact on the drainageways in the newly-urbanized watersheds, and the landscape retains much of its native beauty.

The environmental matrix included a variance clause, which was designed to allow the Director of Planning sufficient latitude to accommodate the heterogeneous nature of the Wildwood landscape. Several new subdivisions required considerable public debate and some modifications of the environmental guidelines. Results have been very positive, and it is clear that the Director of Planning, as a consequence of ten (10) years of experience with the matrix and "in the field" discussions with soil scientists, has an excellent understanding of the matrix and the implications of its use. The resulting variances have been effective compromises for both builders and the environment.

Three (3) specific examples of "negotiated engineering" are noteworthy. The bridge at McBride Pointe Drive/Strecker Road evolved through a negotiation/discussion process that was truly multidisciplinary. Geologists, engineers, hydrologists, and soil scientists met with City staff to discuss the interactions among the bridge, stream flow, existing bank erosion, aesthetics, and budget. The result was a bridge and related "living wall" engineered together. The rapidly eroding cut bank downstream from the bridge functioned, as designed. No ancillary negative effects from bridge construction were observed in three (3) years of monitoring, after the bridge was built. The bridge was a success, and the process through which it evolved set a template for planning and designing similar structures through a careful, multidisciplinary process. Unfortunately, the template does not seem to have been considered in subsequent bridge designs.

The Wynncrest Subdivision required a variance for the access road. The site contained two (2) ephemeral drainageways, with native vegetation and deep, loamy soils that are excellent for environmentally sustainable storage and transmission of surface water. The Director of Planning initiated, and sustained, multidisciplinary meetings with the Metropolitan St. Louis Sewer District (MSD), the builder, and soil scientists. Compromises eventually were made by all, and a creative, innovative, and environmentally sound detention basin design resulted that allowed retention of most of the native vegetation, involved no soil removal or paving in the ephemeral drainageway, and greatly reduced both water and soil loss from the site. This detention basin design should be a template for other new subdivisions, and would help minimize environmental consequences of urban stormwater runoff.

The Deer Valley Subdivision, which has been approved, but not yet built, involved a long sequence of public discussions and site plan modifications. Soil scientists visited the site several times, with plans in hand, making lot-by-lot observations and assessments. The result was a plan that ultimately resulted in precise placement of home sites in a way that optimized conditions for both the builder and the environment and still adhered to the original intentions of the environmental ordinances.

Stream Monitoring

Stream monitoring produced data on channel cross-sections and bank erosion rates, but determining cause-and-effect of individual rainfall and stream flow events proved very difficult. Flow velocity and volume in the main channels could not be measured. The energy of flow destroyed the flow-measuring hardware. Flow measurements were taken in smaller tributaries and stormwater outlets. Temporal and spatial variabilities of bank conditions, flow dynamics, and rainfall duration and intensity interact to create an extremely complex system. However, the time spent in the stream under the range of conditions, and the repeated cross-bank and erosion measurements at selected places, produced not only data, but also a tacit understanding of system behavior. One of the important lessons learned is that "hard fixes," such as rip-rapping eroding banks, seldom succeed, and often accelerate downstream erosion. It is essential that earth scientists and engineers spend "time in the stream" to acquire knowledge of system dynamics and processes and to understand that "standard" approaches will not succeed in this stream system. Erosion is not constant, but is episodic. Erosion rates are determined by bank conditions, including seasonal wetness, and by duration and intensity of stream flow events. Continuous monitoring of erosion sites is necessary to prioritize remediation and avoid costly, often dangerous, infrastructure failure.

Important Remaining Problems

Caulks Creek remains a stream system in transition. The volumes and intensities of stormwater-induced stream flow, and the environmentally fragile nature of the Wildwood landscape, combine to create a situation that ensures stream bank erosion will continue for years to come. The stream has not yet reached a steady-state condition with its urbanized watershed. Bank erosion continues, and threatens several key locations. It is important for the citizens of Wildwood to understand that the battle against erosion in Caulks Creek will not end in the foreseeable future. A focused, long-range, prioritized plan of remediation should be developed.

The Strecker Road cutbank is now at a critical stage. The bank, which was 48 feet from the road in 1997 (and 120 feet from the road in 1966), is now 14 feet from the road. This consultant has been very reluctant to estimate dates of impacts due to stream erosion – the system is too complex and dynamic. However, recent erosion rates and observations make it seem reasonable to predict this cutbank will reach Strecker Road within two (2) years at the present rate of erosion. Erosion seems to have accelerated dramatically, as a consequence of the ill-advised placement of an access road to Woodcliffe Heights Subdivision, and installing a stormwater runoff drain on the east side of Strecker Road, and directing part of its outfall into an ephemeral drainageway adjacent to the Strecker Road cutbank (Figure 1).

Several years ago the City hired Wright Water Engineering, a nationally known firm with experience in high-energy stream systems on the Colorado Front Range, to design mitigation for the Strecker Road cutbank. An outline of that design is in the new environmental report. It is imperative that a plan be approved and funded to begin remediation of the Strecker Road cutbank, as soon as possible. Failing to do so will result in bank erosion that impacts Strecker Road, near Woodcliffe Heights Subdivision.

Lessons learned from the successful design and construction of the McBride Pointe Drive Bridge do not seem to have been applied to design and construction of new bridges at the intersections of Shepard and Strecker Roads and at Lone Cabin Drive and Valley Road. Accelerated stream bank erosion already has resulted from the bridge at Lone Cabin Drive and Valley Roads because of the placement of the bridge footings and the failure to adequately incorporate a sustainable plan to minimize downstream bank erosion. The downstream cut bank erosion has accelerated, and both Lone Cabin Drive and Valley Road now are threatened by bridge-induced shifts in erosion dynamics.

The City needs to create a system to systematically and regularly observe and monitor places in the Caulks Creek Watershed, where bank erosion threatens roads and other infrastructure. Many of these locations are identified in the environmental report. The City should create a priority list for a long-range, systematic remediation of the most threatening locations. The City also needs to institute a system to monitor post-construction sites. Detention basin bank erosion, appearance of sinkholes, erosion during and after construction, and improper channeling of water from stormwater pipes continue to be important, pervasive problems.

Discussions accompanying the original Master Plan focused on the importance of finding ways to retrofit and utilize existing detention basins, in an effort to reduce and slow transmission of stormwater runoff to the Caulks Creek system.

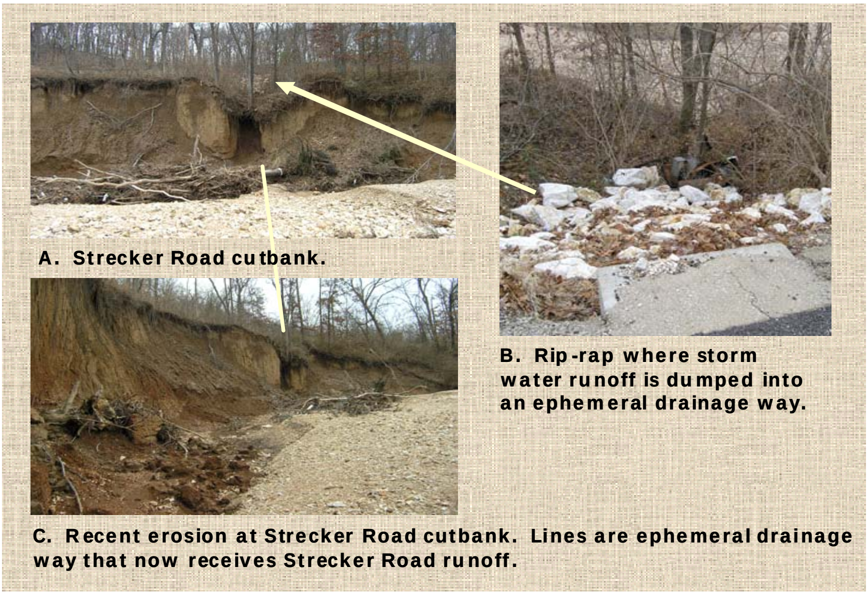

Figure 1. Three (3) views of Strecker Road cutbank. "A" is from the stream toward Strecker Road. "B" is from Strecker Road toward Caulks Creek, looking down toward the rip-rap below the new storm water runoff pipe that dumps into the creek. "C" is a view along the cutbank showing recent erosion. The arrow from B to A shows the rip-rap in Figure A. The line in A and C shows the same ephemeral drainage way in both photographs.

A design for a variable rate water discharge system is included in the environmental report. It is strongly recommended the City fund a pilot study of this design and develop a plan to retrofit and utilize the many existing detention basins in the Caulks Creek Watershed.

Conclusions

The environmental ordinances appear to have had the intended result of preventing stormwater induced degradation of stream systems in newly-constructed subdivisions. The City's Director of Planning has been innovative in applying the ordinances and in trying to find ways to reduce building-induced stormwater runoff.

Newly constructed bridges, while necessary because of the deteriorating structural conditions and eroding banks of older bridges, do not seem to have been designed and constructed with considerations and knowledge of site-specific stream flow and bank conditions. New, unnecessary, environmental problems are being created as a consequence. These, in turn, will become future financial problems for the City. The majority of any City's budget generally is spent on public works, specifically roads and bridges. Such public works' projects need to take both a scientific and fiscally sound long-range look at the stream system, when replacing infrastructure, and needs to involve stream hydrologists in the planning discussions.

A focused, systematic process should be emplaced to monitor stream erosion and plan for prioritized remediation of erosion, where important infrastructure is threatened.