Chimes Creek Bank Stabilization and Channel Restoration Feasibility Study

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Prepared for:

City of Oakland, CA
Community Economic Development Agency
Watershed and Stormwater Management
250 Frank H. Ogawa Plaza, Suite 4314
Oakland, CA 94612-2034

Submitted by:
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September 2009

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PREFACE

A bank stabilization and channel restoration feasibility study was prepared for Chimes Creek between Delmont Ave and the Alameda County Flood Control District culvert entrance near Nairobi Place in the City of Oakland, CA. Questa Engineering Corporation prepared this feasibility study under contract with the City of Oakland's (City) Watershed and Stormwater Management Department as part of a consent decree reached between the Millsmont Homeowners Association (MHA) and the City of Oakland (MHA, 2008). The primary goal is to investigate and provide feasible restoration alternatives for Chimes Creek.

Specific ***Project Goals*** include:

- Execute topographical, biological, and geomorphic mapping in support of project design and alternative development;
- Conduct focused hydrological survey and hydraulic analysis relevant to feasibility study.
- Review and analyze existing hydraulic and geomorphic conditions/constraints;
- Communicate with MHA regarding various bank stabilization and channel restoration techniques and urban geomorphology;
- Develop and design conceptual restoration alternatives to meet hydraulic, geomorphic, biological (habitat), regulatory (permitting), and community constraints;
- Recommend restoration alternatives to the City and MHA;
- Propose a project schedule and feasibility level cost estimate for the recommended conceptual alternatives that includes final design, bidding, and acquisition of required permits.

This feasibility report is a conceptual plan that has been developed through a technical planning process which included the completion of detailed biological, geomorphic, and hydrologic analyses, and the development and screening of restoration alternatives, through a series of meetings with City staff and local residents. This feasibility report provides detailed hydrogeomorphic information and potential restoration alternatives to thwart further private property loss along Chimes Creek and restore a natural riparian community. This study should guide the subsequent development of more detailed engineering drawings which will be necessary for project construction.

EXECUTIVE SUMMARY

This report presents a feasibility analysis of bank stabilization and channel restoration along Chimes Creek in the City of Oakland, CA (**Figure 1**). The first part of the report investigates existing conditions with a hydrologic review, geomorphic assessment, and hydraulic modeling of 1,150 lineal feet of channel along Chimes Creek in the Millsmont neighborhood between Delmont Ave and the Alameda County Flood Control District culvert entrance near Nairobi Place (**Figure 2**). The second component of the feasibility analysis provides three restoration design concepts and a permitting/construction schedule for project implementation.

Preparation of this feasibility report and the conceptual designs were based on detailed topographic surveying, and focused geomorphic, hydrologic, and biological reviews as required in the approved consent decree (See Attachment 2) between MHA and the City of Oakland. The goal of the feasibility report was to provide alternatives to combat ongoing erosion issues and restore Chimes Creek using hydraulic, hydrologic, and geomorphic analyses to the extent required for a feasibility level design.

The focus of the report was to provide options for restoring and stabilizing the erosion in Chimes Creek between Delmont Ave and Nairobi Place. Restoration and design options were derived from a review and analysis of previous hydrologic studies, as-builts, and drainage plans. Determining exact peak discharges through extensive modeling of the Leona Quarry development, the undersized City storm drain network, and adjacent contributing areas was not the focus of this feasibility report. This report initiates the process of restoration and recovery of a public and private natural resource by providing documentation for future funding issues, permitting, and design alternatives to move the project forward.

An updated section describing previous studies, current assumptions, and their effect on design alternatives has been included (See *Hydrology* in Section 1 "Setting"). Previous hydrologic reports were not primarily concerned with the outflow to the Chimes Creek project reach; however they provide a starting point for the feasibility level restoration design provided in this report. The flows used to generate and review alternatives were chosen as conservative estimates and are adequate for addressing the goal of stabilizing and restoring Chimes Creek at this stage. Final design plans can include adjustments to rock size, lengths of coir log and rock toe protection, and channel roughness to easily compensate for changes in the flows predicted in this report.

This report takes a reach based approach to determining restoration strategies because much of the watershed is urbanized and has significant constraints on offsite alternatives. The project reach is experiencing instability and this report provides techniques to stabilize and restore the channel under the current hydrologic conditions. Geomorphic analyses and historical observations from residents in the project area suggest Chimes Creek has incised some 8 to 12 feet over the last 50 years, creating over-steepened and unstable banks that are susceptible to slumping and failure. Overall, erosion problems in Chimes Creek are directly related to land use changes over the entire watershed that have decreased coarse sediment input and increased surface run-off. Chimes Creek is adjusting to a lower sediment supply and increased peak flows by eroding the channel bed throughout the unculverted sections of the project reach.

Without action, continued vertical degradation ranging from 4 (downstream) to 22 ft (upstream) is possible.

An inventory of the entire study reach found two major sections that differ by the magnitude and type of erosion conditions. The lower section of Chimes Creek (STA 0+00 – 7+00) is dominated by vertical incision, toe undermining, and shallow geotechnical slump failures that lead to channel widening and property loss. The upper section of Chimes Creek (STA 7+00 – 11+50) is not dominated by vertical incision and bank failure zones and instead contains a well connected floodplain and only minor bank erosion. Streams with well connected floodplains leave their banks and distribute high flows and bed shear stress over a larger surface area. Therefore, flooding does not always indicate erosion issues. This bank stabilization and channel restoration feasibility study is intended to provide alternatives to combat ongoing erosion issues along Chimes Creek; the overwhelming majority of which occur in the lower section of the project reach. Therefore, the primary goal of all bank stabilization alternatives was to stop vertical incision and stabilize bank slopes below the concrete structure on parcel #037A277201400 and limit changes to the stable flood prone upper areas of the project reach. Erosion issues upstream of STA 7+00 will be controlled with small hand constructed bio-technical stabilization techniques discussed in Section 6 “General Approaches to stabilization.”

In **Alternative 1** the channel profile and cross sectional shape will be re-graded to an equilibrium slope and form using elevated grade controls of large immobile boulders keyed into channel banks to minimize further incision from STA 0+00 to 7+00. To minimize flood impacts to existing structures, the minor erosion areas in the upstream section (7+00 - 11+50) will be treated with hand placed biotechnical measures such as willow stakes, erosion control mats, and willow fascines. Throughout the lower section, adjacent channel banks will be re-graded and slopes engineered and protected with a combination of seeding, erosion control blankets, native riparian plantings, and coir fiber roll toe protection. Channel bed fill material will be imported as necessary. Cost of this alternative is estimated to range from $550,000-$670,000. Although in the short term Alternative 1 is more expensive and requires property owners to accept channel grading into portions of their yards, in the long term this alternative will likely have fewer subsequent reactionary maintenance problems, and will provide superior private property protection.

Alternative 2 includes strategically placing grade controls at current stream profile elevations along the channel and re-grading adjacent slopes only where necessary for construction access. Fill will not be used to increase channel elevations. Grade controls installed at current knick-points will prohibit further vertical incision. Additional bio-technical bank stabilization measures like brush mattresses, erosion control blankets, biodegradable toe protection, and riparian vegetation plantings will be installed to stabilize actively eroding banks below STA 7+00. Upstream erosion areas (STA 7+00 – 11+50) will be treated with minimal live willow staking and erosion control fabrics to limit flood level changes. Cost of this alternative is estimated to range from $400,000-$490,000.

Alternative 3 will not contain grade controls or additional bank stabilization measures along channel banks. Instead, a roughened channel, composed of rock calculated to be immobile during the 25-yr event will be laid on top of the existing channel bed throughout the lower

section of Chimes Creek. The roughened channel will mitigate vertical incision, and coir fiber rolls with willow stakes installed along bank toes will mitigate toe scour and lateral movement of the channel. Minor grading and stabilization will be performed only where construction access necessitates widening of the channel. Cost of this alternative is estimated to range from $257,000-$315,000.