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Sustainable Development and Green Growth: Study of Lafayette Central Park Proposed Master Plan, USA

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Abstract

Lafayette consolidated government purchased "Horse Farm", therefore plans are undergoing to develop it into a city park. The developments proposed to the city park have implications for the hydrologic and hydraulic conditions of the main channel that runs through the park, Coulee Mine, and its overall watershed. The proposed master plan is suggesting two main changes: (1) Converting the concrete coulee into natural coulee and, (2) Adding natural lakes to the right bank of the coulee. This paper is focusing on investigating the effects of the proposed project on the entire watershed. The investigations are conducted using numerical modelling techniques; namely the HEC-HMS and HEC-RAS models. Finally, the changes in water surface profiles, flow hydrographs across the Coulee Mine channel and storage of the natural lakes added are investigated.

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Keywords: Sustainable development; Watershed; Green growth; Modelling; Lafayette central park.

1. Introduction

Lafayette consolidated government purchased a 100-acre "Horse Farm" from the University of Louisiana at Lafayette. Plans are undergoing to develop the Horse Farm into a city park, for which a master plan has been prepared. The park at the Horse Farm programming and master plan produced from the efforts of government and design workshop to engage the community and determine the programming needs and master plan of the park. The

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developments proposed to the city park have implications for the hydrologic and hydraulic conditions of the main channel that runs through the park, Coulee Mine, and its overall watershed [1].

2. Literature Review

Predicting runoff for watersheds has a big concern form hydrologists and engineers. Different types of models are available to represent rainfall-runoff relationships. However, limitation of most rainfall-runoff models are that hydrologic parameters used to describe the rainfall-runoff process in watershed systems which must be calibrated and verified based on historical measured rainfall and flood events. The relationship between rainfall and the resulting runoff has been extensively studied, and many prediction methods of varying complexity have been developed.

Bakir and Xingnan [2] compared between the HEC-HMS and the Xinanjiang conceptual model using historical flood data from the Wanjiabu catchment in China. The results indicated that HEC-HMS is more convenient for flood stimulation especially in optimizing parameters. Dong and Moo [3] used XP-SWMM model to calculate water harvesting and flash flood estimation in flood prone area in Suwon of South Korea. Abbott et al. [4] introduced the SHE, a physically-based, distributed, catchment modelling system. The physical basis and flexible operating structure of the SHE allows the model to use as many or as few data are available. Abu El Nasr et al. [5] assessed the performance of two different models, the fully distributed MIKE SHE model and the semi-distributed SWAT model. The analysis revealed that both models are able to simulate the hydrology of the catchment in an acceptable way. Archuleta et al. [6] reviewed the U.S. Geological Survey cooperation with the Texas commission on environmental quality computer scripts and applications to automate the delineation of watershed boundaries and compute watershed characteristics in Texas.

Bergstrm and Graham [7] addressed the problem of scales and particularly the modelling of macro or continental scale catchments in hydrology. Carpenter and Konstantine [8] determined the manner with which rainfall input and model parameter uncertainty shapes the character of the flow simulation and prediction uncertainty of distributed hydrologic models. Fitzpatrick et al. [9] used spearman correlation and redundancy analyses to examine relations among biotic metrics and environmental characteristics in eastern Wisconsin. Leandro et al. [10] disclosed a methodology for considering the variability of building types and the spatial heterogeneity of land surfaces. Results highlighted that the addition of multiple urban features have a higher cumulative effect due to the dynamic effects simulated by the model.

Lu et al. [11] used non-parametric Mann-Kendall tests to examine long-term hydro-climatic (precipitation, temperature, stream flow) trends in WE-38 in the context of recent climate change across northeastern US. Raiford et al. [12] developed the depth-duration-frequency curves and maps for the region encompassing South Carolina, North Carolina, and Georgia. Marusa et al. [13] analyzed the flash flood parameters and human impacts in the US.

3. Description of Project Area

3.1. The Boundaries

The park is one of the last large undeveloped parcels of land centrally located within Lafayette. With the exception of the Coulee Mine paving, dirt roads, and a small farm building on site, the park is largely in a natural state. It is bordered to the north by Johnston Street and a number of commercial and office land uses. To the west, south and east, there are the Oakleaf, Greenbriar, and South College neighbourhoods, respectively, see Fig. 1. The Coulee Mine cut-off canal that begins in the Horse Farm property continues along city-owned property to rotary point, a public boat launch on the Vermilion River, creating the potential to tie into the bayou waterway system in the region.