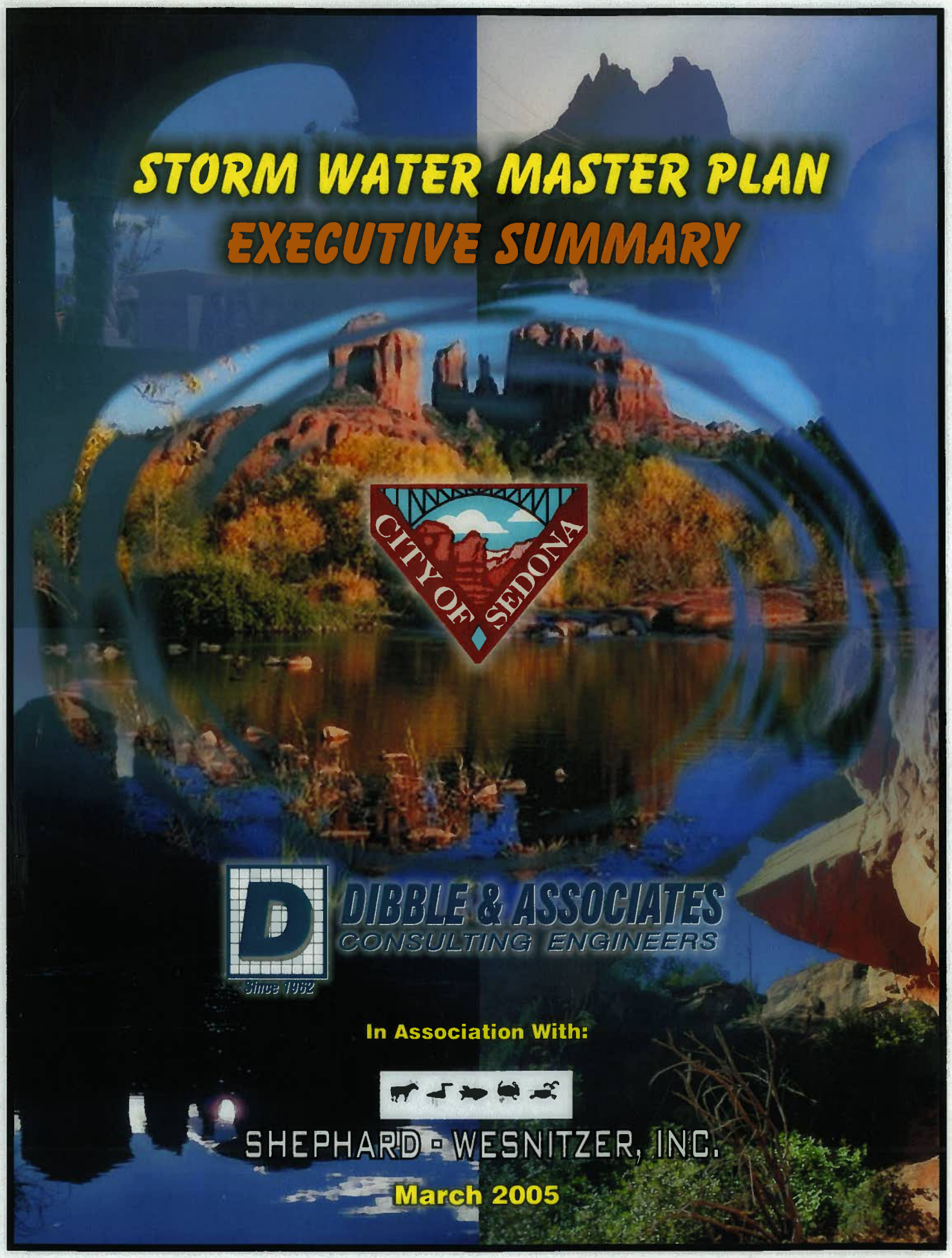
STORM WATER MASTER PLAN
EXECUTIVE SUMMARY
CITY OF SEDONA
DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1952
In Association With:
SHEPHARD • WESNITZER, INC.
March 2005

CITY OF SEDONA
STORM WATER MASTER PLAN

EXECUTIVE SUMMARY

PREPARED FOR:

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PREPARED BY:

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March 2005

EXECUTIVE SUMMARY

Introduction

The City of Sedona retained the professional engineering services of Dibble & Associates Consulting Engineers, Inc., of Phoenix, Arizona, on March 26, 2003 to conduct the Storm Water Master Plan Project for the City. The Storm Water Master Plan Project was conducted with the following objectives:

(1) To develop a Storm Water Management Plan associated with the City's compliance with the Arizona Pollutant Discharge Elimination System (AzPDES) requirement. This element of the project focused on measures to maintain and improve the quality of stormwater discharged into Oak Creek and its tributary drainages from the City of Sedona.

(2) To develop a Storm Water Facilities Master Plan aimed at determining drainage improvements within the City leading to the development of the Capital Improvement Plan (CIP). This element of the project focused on measures to convey certain flows through various areas of the City without significant flooding.

Storm Water Management Plan

The Storm Water Management Plan addresses the minimum measures from which best management practices were identified as guides to effectively implementing the storm water management program. The Arizona Department of Environmental Quality (ADEQ) mandated six measures for the Plan, however, the City choose to include seven measures in its plan. ADEQ required the plan to cover a period of five years, to December 12, 2008. The seven measures are:

(1) Minimum Control Measures for Public Education and Outreach *(Permit Condition V.B.1)*
(2) Minimum Control Measures for Public Participation/Involvement *(Permit Condition V.B.2)*
(3) Minimum Control Measures for Illicit Discharges Detection and Elimination *(Permit Condition V.B.3)*
(4) Construction Site Stormwater Runoff Control *(Permit Condition V.B.4)*
(5) Minimum Control Measures for Post-Construction Stormwater Management in New Development and Redevelopment *(Permit Condition V.B.5)*
(6) Pollution Prevention/Good Housekeeping for Municipal Operation *(Permit Condition V.B.6)*
(7) City Implementation *(Permit Condition V.B.7)*

The completed Storm Water Management Plan document was approved by the City Council in November, 2003, and submitted to ADEQ for approval in December 2003. The City has been working with the Environmental Protection Agency (EPA) to effectively implement the developed storm water management program.

A City storm sewer system map was prepared as part of the overall project. This map shows existing storm water facilities in the City and all the 12-inch diameter or greater outfalls along Oak Creek. This map is an aid in identifying the paths that storm water takes through the City on its way to Oak Creek. This map will aid in relating the impact of

stormwater discharges at Oak Creek to the possible sources of those discharges. The outfalls are key to identifying and selecting monitoring stations by ADEQ from which to monitor water quality for Oak Creek, should that become necessary. Currently the Plan does not require storm water quality monitoring. The Storm Water Management Plan is a separate volume from this document; however, the Minimum Control Measures are included in this document as APPENDIX L.

Storm Water Facilities Master Plan

The Storm Water Facilities Master Plan recommends a $ 14,013,304 capital improvement plan consisting of 107 capacity related storm water facilities projects. These projects are to be implemented by the City as part of a fifteen-year drainage improvement program. The Facilities Master Plan addresses five major drainages passing through the City and five selected smaller areas. Consequently the Plan does not address every area of the City. The Plan provides a process for addressing the unaddressed areas that is consistent with the areas that have been analyzed. It was the intent of the project that analyzed areas serve as templates for addressing other areas in the future. The major tasks leading to the development of the Capital Improvement Plan are: *data collection, storm water facilities inventory, hydrology update, evaluation of existing drainage facilities, recommendation of drainage improvement projects,* and *capital improvement plan*. These tasks are briefly described in the following subsections.

Data Collection. A valuable part of the data collection effort is the public involvement in which City residents were invited to be involved in a citywide flood data survey. The flood data survey was conducted to identify "bottleneck" areas within the City limits that have significant drainage issues such as flooding problems during storm events. Flood locations from respondents were mapped based on the street addresses provided. The concentration of reported problem areas was the determining factor for the location of areas for further analysis. These locations of flooding areas were recommended as minor drainage study areas for the implementation of the drainage design criteria developed for the City.

Storm Water Facilities Inventory. Mapping of drainage facilities for the City of Sedona Storm Water Master Plan was performed by determining the point coordinates of drainage facilities using differentially corrected Global Positioning System (GPS). A total of 765 point features representing drainage inlets and outlets for culverts, augmented by points along engineered channels with a 100-year discharge greater than 250 cfs. Line elements were added to show the channel alignments, and also the pipe networks for storm drainage systems.

Hydrology Update. The existing hydrology models of the watersheds in the City and neighboring areas that drain to Oak Creek were developed in 1993 using Technical Release #20 (TR-20) of the Soil Conservation Service, now called the Natural Resources Conservation Service (NRCS). TR-20 is a computer-based rainfall-runoff modeling program that estimates watershed runoff using the Curve Number Method. Updating the watershed models is a significant part of the project with the goal to utilize existing Geographic Information System (GIS) data sets created and developed by the City's Information Systems Department.

The watershed for the hydrology update covers an approximate total area of 35 sq. miles. The area is subdivided into five major basins – all of which are tributaries to Oak Creek. These five major basins are:

Dry Creek
Coffee Pot Wash
Mormon Wash
Soldier Pass
Oak Creek

The purpose of the hydrologic modeling update was to use current modeling procedures and technology and to develop the hydrologic models of the various watershed areas using GIS. This involves the shift from the use of TR-20 to HEC-1 methodology. HEC-1 (Hydrologic Engineering Center) is a hydrologic modeling computer package developed by the U.S. Army Corps of Engineers. The Curve Number method used to evaluate the soil loss conditions in the TR-20 models is replaced by the Green-Ampt method for the new HEC-1 models. Also, the incremental unit hydrograph methodology (involving the use of time of concentration and the unit hydrograph time increment) used in TR-20 is replaced by the Clark Unit Hydrograph. The normal depth method for the channel routing analysis used in TR-20 is replaced by the Muskingum Method.

The Watershed Modeling System (WMS), developed by Environmental Modeling Systems, Inc., is the hydrologic modeling program selected for the project to develop the watershed models for the major drainage basins. Its use for the project went through a selection process involving five other modeling programs that include SWMM, HEC-1, TR-20, HEC-HMS, and KINEROS. The model selection and evaluation adopted a set of criteria that was defined in the scope of work. APPENDIX A lists and describes this set of criteria and presents the qualitative and quantitative evaluation summaries of the model selection process.

The five watershed models developed using WMS are for the five basins. The topographic data in the form of digital elevation models (DEM) within the City limits were provided by the City augmented by the U.S. Geological Survey (USGS) DEMs for areas outside the City limit. The City DEMs are 2- foot and 10-foot “gridded” data while the USGS DEMs are 10-meter “gridded” data.

WMS (version 7.0) has automated the delineation of sub-basins within the five major drainage areas. Before drainage boundary delineations were performed, locations of drainage outlets were identified taking into consideration City street alignment data, existing drainage outlets used in TR-20 models, and City boundary information. These identified drainage outlets provide relevant discharge data for the evaluation of capacities of existing drainage facilities that involve culverts and drainage ditches or open channels. Some existing sub-basins modeled in TR-20 were either lumped with adjacent sub-basins or redrawn to show new drainage boundaries based on the DEMs provided by the City. Other sub-basins were re-delineated using WMS to reflect the same drainage boundaries from earlier studies.

In the development of the hydrologic models using GIS, WMS 7.0 used the following data sets for the hydrology update task for the five drainage basins identified.

- Digital elevation models (DEM) provided by the City and supplemented by USGS.
- Soils map obtained from the Coconino National Forest
- Land use and zoning maps provided by the City
- Precipitation data evaluated from earlier hydrological modeling efforts involving the TR-20 program.

A comparison between the TR-20 and HEC-1 sub-basin boundaries for the five drainage basins shows some discrepancies in the shape and size of the basins. The discrepancies could be attributed to the following:

- The data resolution of the DEM used by WMS in the sub-basin delineations for the HEC-1 models.
- Engineering judgment exercised by the modelers during sub-basin delineation for the TR-20 modeling effort particularly at areas where high-resolution surface information is very limited.

Results of the 100-year peak flow comparison from TR-20 and HEC-1, and the flows used in Flood Insurance Studies for the Federal Emergency Management Agency (FEMA) are summarized as follows:

- For all the five basins (i.e., Dry Creek, Coffee Pot, Soldier Pass, Mormon Wash, and Oak Creek), the FEMA flows used for the floodplain management studies were generally greater than the HEC-1 flows evaluated for the Storm Water Master Plan. This study indicates that the resultant floodplain maps that evolved from the previous floodplain management studies were generally "conservative."

- The flow comparison made between the HEC-1 and TR-20 models show higher peak flows generated by TR-20 for all the basins studied except for Dry Creek and Coffee Pot.

Evaluation of Existing Drainage Facilities. In order to evaluate existing drainage facilities, trial drainage criteria were developed for use in this study. These criteria were developed in consultation with the Flood Control Districts of Coconino and Yavapai Counties. The City Engineer and Dibble and Associates recommended criteria for situations where County criteria did not exist. These criteria were approved for use with this study by the Sedona City Council at its May 27, 2003 meeting. The City of Sedona did not adopt these criteria for use other than with this study. Should the City choose to adopt the trial criteria as the City's Drainage Design Criteria, consideration should be given to modifying application of the two- to ten-year flow criteria as it relates to roadside ditches.

Five major drainage areas associated with the five major basins were studied in the Storm Water Master Plan. Existing drainage conditions within the main drainage corridors were evaluated from a number of sources that include field investigation and floodplain maps. The five major study areas are:

- Mormon Wash
- Soldier Pass Wash
- Coffee Pot Wash
- Dry Creek Wash
- Oak Creek

The "main stream" of each one of these watersheds was evaluated for recommended facilities. The main stream is defined as the dominant branch of the watershed and is typically coincident with the floodplain and floodway. Side washes tributary to the main stream and private drive culverts were not evaluated in this project.

In addition to the five major drainage corridors described, five minor drainage areas were chosen by the City to be studied in detail. Existing drainage conditions on these areas were evaluated from a number of sources that include field investigation, floodplain maps, flood survey, and from documentation provided by area residents. The main goal of the minor drainage area studies is to document existing drainage issues, evaluate existing drainage facilities, and provide facilities improvement recommendations to the City to address the issues identified. The five minor drainage areas are:

- Harmony Drive Area
- View Drive Area
- Windsong Drive Area
- Saddlerock Circle Area
- Vista Bonita Drive Area

For both the major drainage corridors and minor drainage areas, the 25-year and 100-year flood events were used in the hydraulic performance evaluation of existing facilities and the proposed drainage improvements. Those with deficient drainage capacities were recommended to be upgraded to meet the capacity and design requirements.

Recommendation and Prioritization of Drainage Improvement Projects. In order to program the capital improvement projects over specific timelines based on priorities, the identified projects were ranked from prioritization factors identified and recommended by the City. The project prioritization evaluation was conducted to develop a listing of individual and grouped projects programmed to be undertaken in specific and established order. As resources become available, the CIP will serve as a communication tool regarding what projects and improvements will be undertaken. Should resources become scarce, however, the same CIP will provide a guideline for determining which projects *must be undertaken* from the list of prioritized projects already outlined in the plan.

The ten rating criteria (and their assigned numerical weights) used to prioritize the 117 drainage improvement projects, of which 10 projects were eventually dropped, are:

Life Threat (10)
Property Threat (5)
Nuisance Threat (1)
Cost to Fix (3)
Flood Frequency (5)
Location (3)
Coordination with Other Projects (4)
Extent of Improvements (1)
Easements (1)
Environmental Impacts (3)

Capital Improvement Plan. The Capital Improvement Plan for the City of Sedona is comprised of 107 projects located in four major drainage basins within the City that include Dry Creek, Coffee Pot, Soldier Pass, and Oak Creek. Ten (10) projects were dropped from the initial 117 projects because of their location or the structures in question have adequate design capacities. This CIP implements the drainage design criteria developed for the City for the purpose of improving and mitigating the drainage issues identified at five minor drainage areas and along major drainage corridors.

The CIP includes the following cost schedule for the 15-year period that is envisioned for the program:

	2005 Dollar Value	Projected Cost
First Five-Year Plan:		
1st Year	$ 623,051.	$ 623,051.
2nd Year	$ 660,660.	$ 696,996.
3rd Year	$ 553,721.	$ 616,305.
4th Year	$ 706,125.	$ 829,161.
5th Year	$ 728,210.	$ 902,125.
Total	$ 3,271,767.	$ 3,667,638.
Second Five-Year Plan:		
6th – 10th Year	$ 3,196,382.	$ 4,503,289.
Third Five-Year Plan:		
11th – 15th Year	$ 3,245,263.	$ 5,842,377.
Total Project Cost:	$ 9,713,412.	$ 14,013,304.

The CIP provided is designed to be updated on an annual basis through the operating budget adoption process and amendments to the CIP. In this manner, it becomes an ongoing fiscal planning tool that continually anticipates future costs and funding sources.