

HYDROLOGY IN SIMCITY™ 4: A REVIEW

Introduction

SIMCITY™ 4 allows the user to simulate the creation and management of a city. Hydrology is present in SIMCITY™ 4 and the amount and accuracy of SIMCITY™ 4's hydrologic capabilities will be the subject of this report. First, the history and overview of SIMCITY™ 4 is provided to give a brief synopsis of the evolution of the game and a description of how the game operates. An overview of hydrology in SIMCITY™ 4 is given to demonstrate the existing hydrologic capabilities in the game and what the game does not contain. The existing hydrologic capabilities of SIMCITY™ 4 will be further discussed individually in the report.

Overview and History of SIMCITY™ 4

SIMCITY™ 4 (herein referred to as SIMCITY) is an interactive video game that allows the user to take on the dual roll of a city planner and city mayor. SIMCITY is classified in the video game genre of God Games (also referred to as System Simulation Games) due to the total control and power granted to the user [1]. The user is allotted a region of land and within this region the user selects a parcel of land on which to construct a city. The user can alter the physical features of the parcel of land through the use of assorted functions such as utilizing the GORGE VALLEY function to create a canyon in an area that was originally flat. Once a desired site for the city is determined and land alterations have been performed, the user will incorporate the city or switch into Major Mode. The user will then start to construct the city by demolition of unwanted land features (i.e. trees). The user will decide the type of land zoning, commercial, residential or industrial, and the extent of usage, low, medium or high. As in real world applications, the user will need to provide various utilities (i.e. power, water) before the area is inhabited [3]. Once utilities are provided, the SIMS (residents of the city) will settle the land. This process will continue as desired by the user.

In addition to the total control bestowed to the user on the design of the city, SIMCITY also incorporates the necessities and burdens associated with urban areas. A highlight of the necessities are the need for a water treatment plant, a power plant, sanitation control, police and fire stations, hospitals, educational facilities, recreational parks and an adequate transportation system. A partial listing of the burdens is crime, fire, disease, pollution and worker strikes [3]. The user is provided an advisor panel which consists of city officials that provide expert insight on the various aspects of city planning and administration. The user has the option to view a number of graphs, city opinion polls and budgets. The graphs depict city data over and allow the user to view trends over certain time periods. The city data available to the user includes water pollution, water supply, commuter time and education. City opinion polls provide city development in environmental, safety, health, traffic, education and land value. Budgets allow the user to track numerous city expenditures and serves as a cost break down. The currency used in SIMCITY is the Simoleon (§).

The first version of SIMCITY, SIMCITY CLASSIC was originally created by William Wright in 1985 [1]. Wright and Jeff Braun formed Maxis™, which published the first version of the

SIMCITY series in 1989 [1]. SIMCITY CLASSIC was subsequently followed by SIMCITY 2000 and SIMCITY 3000. The latest edition of the SIMCITY series is SIMCITY™ 4. Electronic Arts (EA) now distributes the SIMCITY games under the EA Games label. EA Games has also produced numerous “spin offs” to the SIMCITY series including Sims™ 2 and The Urbz: Sims in the City. SIMCITY™ 4 has drawn praise from numerous video gaming critics including Gaming Excellence which stated “Gaming Excellence selects SimCity 4 for the [Editors Choice Award](#). ‘SimCity, the word is synonymous with success. Ever since the initial title in this extremely popular series was released was back in 1989, the franchise has become world renowned and recognized in nearly every continent on the planet...’ [2].” IGN continued the praise for SIMCITY in the statement “IGN announces SimCity™ as one of the [Top 100 games of all time!](#) IGN declares, it “ranks among the most addictive games ever created [2].”

Overview of Hydrology in SIMCITY

SIMCITY includes some components of the Hydrologic Cycle while omitting a fair number more. A summary of the components of the Hydrologic Cycle that are or are not present in SIMCITY is identified below in Table 1. SIMCITY does contain erosion and water pollution.

Table 1: Components of the Hydrologic Cycle

Component of Hydrologic Cycle	Present in SIMCITY (Yes/No)	Quantity an Issue (Yes/No)	Quality an Issue (Yes/No)	Comment
Stores				
Groundwater	Yes	No	Yes	Underground aquifers are present. There is an unlimited supply of groundwater. Groundwater pollution is present.
Rivers	Yes	No	No	Rivers are present in SIMCITY.
Lakes	Yes	No	No	Lakes are present in SIMCITY.
Estuaries	Yes	No	No	Estuaries are present in SIMCITY.
Ocean	No	-	-	
Fluxes				
Precipitation	No	-	-	
Infiltration	No	-	-	
Evaporation/Transpiration	No	-	-	
Surface Runoff	No	-	-	
Stream Flow	No	-	-	
Drinking Water Distribution	Yes	No	Yes	Drinking water distribution is present. There is an unlimited supply of drinking water from the underground aquifers. Pollution is present if the groundwater is polluted.
Stormwater Collection	No	-	-	
Wastewater Collection	No	-	-	

Rivers, Lakes and Estuaries

Rivers, lakes and estuaries are present in SIMCITY and there are no hydrologic issues (i.e. quality) associated with the rivers, lakes and estuaries. Rivers, lakes and estuaries provides water transportation and recreation. Water transportation is available in the form of passenger ferries and seaports. Water recreation exists in SIMCITY in the form of a marina.

Erosion

SIMCITY contains the ability to have the shoreline and landscape undergo severe erosion. Shoreline erosion is a user controlled function under the Erosion command in the LEVEL TERRAIN menu. The user can utilize the shoreline erosion function to change shoreline features or increase river dimensions as desired. The entire landscape can also undergo erosion by using the Erode command in the TERRAIN EFFECTS menu [3]. The Erode command uniformly erodes the landscape of the region. The Erode command will first remove any forestry and then will reduce the surface features (i.e. hills) upon multiple use of the command. The Erosion and Erode commands allow the user alter the physical land features to create a desired region to build a city upon. The Erosion command is focused over a particular area and the Erode command encompasses the entire region. Shoreline erosion and landscape erosion do not transpire once the user has incorporated the city or entered into Major Mode. The erosion function must occur before the city is incorporated or before the actual zoning and constructing of the city commences [3].



Figure 1. A screen shot of the Erosion command. The green oval indicates the area that is subjected to Erosion.

The term “erosion” as used in SIMCITY can be misleading. Erosion usually refers to the process of soil reduction due to the forces exerted onto the soil by water or wind. SIMCITY uses the term “erosion” as the process of shaping or altering land primarily located around a waterway. SIMCITY does not allow shoreline erosion to occur as a natural or simulated occurrence, but only as a user controlled function before the creation of the city has taken place. There is no specified or quantified amount of erosion that occurs when the user prompts one of the erosion functions. The extent of erosion will be the area of land located within the user-specified area

(Figure 1).

Water Supply and Distribution

The major and most prominent hydrologic capabilities of SIMCITY are in the area of urban water supply and distribution. As in a real city, water distribution and the corresponding infrastructure is a major necessity and the lack of adequate water distribution will reduce the potential population of the city. During the early stages of city planning, the user is advised to provide low density residential zoning. SIMCITY assumes that the residents of the low density residential zoning area will provide themselves with water (i.e. wells) from an underground aquifer at no cost to the city. Once the city contains medium and high density residential development, a public water supply must be provided. Public water is also required for all for

commercial and industrial zoned areas. The water supply can come in the form of water towers or pump stations. The water source for the water supply facilities is always an underground (groundwater) aquifer. The user must run pipelines from the water supply facility to the areas in need. The user will be required to construct additional water supply facilities as a function of the growth of the city. Larger water facilities will be made available to the user once the city's population has reached the minimum requirement.

SIMCITY has an infinite amount of groundwater which translates into the nonexistence of water availability issues such as groundwater depletion.

The user can view the water supply infrastructure by initiating the Water data view. The Water data view will provide the locations of the water mains and water supply facilities, and the area of water distribution including which buildings are "watered" and "unwatered". A color code system is incorporated to illustrate whether the area is watered (blue), unwatered (red) or a water supply facility or water main (green). A screen



Figure 2. A screen shot of the Water data view depicting the water supply infrastructure. Blue indicates an area supplied with water, red indicates an area without water and green indicates a water supply facility or water main.

shot of the Water data view is located to the right. Knowing the area of water distribution will allow the user to construct the next water supply facility in a location that will maximize distribution or provide water to the largest area possible without overlapping with the distribution area of another facility. The user can witness the construction of the water main using the Underground View [3].

SIMCITY provides a Water graph which is a plot of water capacity versus time. A Water graph is illustrated to the right. This Water graph provides insight on water usage with respect to current water capacity. The Water graph is in the form of a historical trend over time and the user has the ability to adjust the time scale. Time scale ranges from one year ago to five-hundred years ago. The Water graph will allow the user to plan according for when, where and what size of a water supply facility to construct.



Figure 3. A standard Water graph. The blue trendline is the existing water capacity and the green trendline is water usage. The sudden increase in capacity is most likely due to the construction of a water supply facility. The units of the y-axis are cubic meters and the units for the x-axis are months.

Types of Water Supply Facilities and Infrastructure

SIMCITY allows the user to choose from three different types of water supply facilities. The types of water supply facilities in the order of least production are a Water Tower (Figure 4), a Water Pump (Figure 5) and a Large Water Pump (Figure 6). There is no direct correlation between the different types of water such as the Water Pump pumping groundwater and depositing it into the Water Tower. The different types of water supply facilities that are present in SIMCITY are identified below in Table 2.

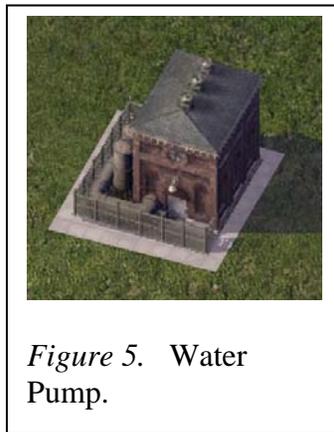
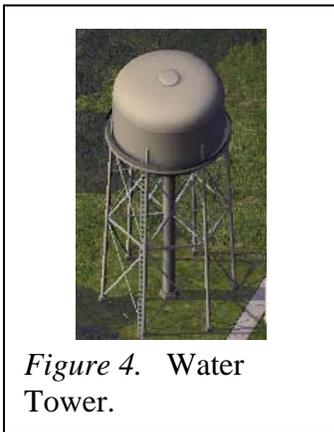


Table 2: Types of Water Supply Facilities

Type	Construction Cost (\$)	Monthly Operations Cost (\$)	Production (m ³ /month)	Requirements
Water Tower	150	50	2400	None
Water Pump	1400	350	20000	None
Large Water Pump	15400	3150	200000	Water demand of 40,000 (m ³ /month) or a population of 10,000 people
Water Treatment Facility	15000	350	2400	None
Pipes	9	10	N/A	None



Figure 7. A standard Water Treatment Plant in SIMCITY.

SIMCITY contains a Water Treatment Plant. The purpose of the Water Treatment Plant is to treat water and eradicate any pollution that exists in the city's water supply (water pollution is further discussed below). The Water Treatment Plant is an independent structure and does not adjoin any of the water supply facilities. A depiction of a Water Treatment Facility is located to the left.

The user must construct a water main or pipeline from the water supply facility to the area of need. No connections for house services are required; the user only needs to provide the water main in the vicinity of the building. The water mains provide service to six tiles on each

side of the main. A tile is area where one house or small structure can occupy. Six tiles are approximately half of a city block in SIMCITY. If the water supply is running low, the supply area of the water mains will be reduced [3]. SIMCITY does not consider pipe sizes or material.

Problems in Water Supply Infrastructure

Problems in the water infrastructure do arise in SIMCITY. One problem is that the water pipes will break due to deterioration. The deterioration is caused from lack of maintenance associated with a reduction in the budget for the water department [4]. Pipe burst will cause water sprouts that can destroy surrounding buildings. To prevent pipe breaks along the same line of the pipe burst, the user should replace the water line or increase the budget of the water department [4].

The other major dilemma in SIMCITY's water infrastructure is that the pump stations may not be functioning. The first reason for the pump station not to function is due to a lack of power. The second reason that the pump station may not be functioning is due to a water pollution problem. To amend a pollution problem, a Water Treatment Plant will need to be constructed or pump stations at a non-polluted location will need to be constructed [4].

Water Pollution

Water pollution in SIMCITY is a result of the farms or the industrial density developments [3]. The water pollution will contaminate the groundwater supply and the user will need to rectify this situation if public water supply facilities are located in the zone of water pollution. Water pollution is a result of farms or industrial density developments and is not a natural occurrence. The user can employ the Water Pollution data view which will provide a depiction of the areas where water pollution is present. A screen shot of the Water Pollution data view is located above. The Water Pollution data view illustrates water pollution in terms of concentration

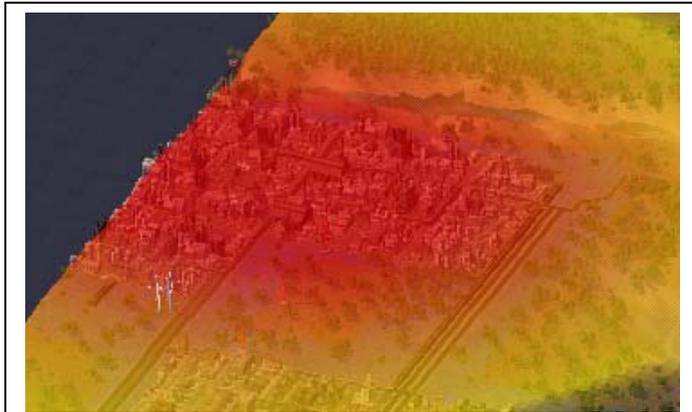


Figure 8. A screen shot of the Water Pollution data view. Red indicates an area of high water pollution concentration and yellow indicates an area of low water pollution concentration.

amounts. The different levels of concentration are represented by a spectrum of different colors with yellow representing an area of low pollution and red representing an area of high pollution. Water pollution will decrease the output of the water supply facilities [4]. The user is advised not to construct water supply facilities in the vicinity of industrial density developments especially the high industrial zoned area due to the high likelihood of groundwater contamination [4]. Water pollution in SIMCITY is limited to the public water supply facilities. The only effect of water pollution in SIMCITY is the decrease in the amount of water supplied by the water supply facilities and water pollution does not affect the residents of the city (i.e. disease).

A Water Pollution graph is present in SIMCITY. The Water Pollution graph is a plot of the amount of Water Pollution versus time. This graph provides a representation of the amount of water pollution with respect to current water capacity. The Water Pollution graph is similar to the Water graph in that the graph is a historical trend over

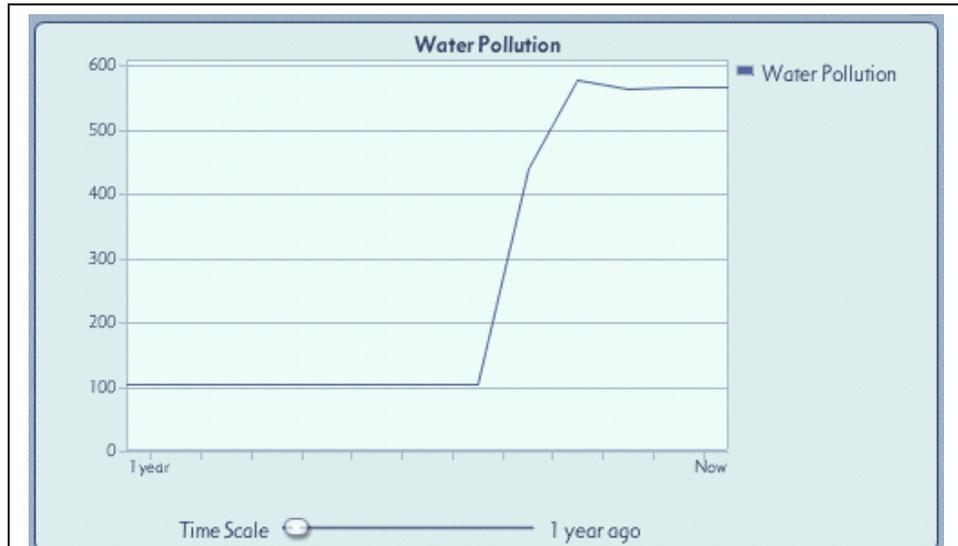


Figure 9. A standard Water Pollution graph. The rapid increase in water pollution is most likely caused by the construction of a water supply facility in an industrial density development or near farmlands. The units of the y-axis are cubic meters and the units for the x-axis are months

time. The Water Pollution graph is depicted above. The Water Pollution graph will aid the user in the determining the location of the Water Treatment Plant or the area in which to construct a water supply facility that is not located in an area of water pollution.

References

[1] "The History of SimCity," http://simcity.ea.com/about/inside_scoop/sc_retrospective.php [Online], August 2005.

[2] "SimCity 4 Media Buzz," http://simcity.ea.com/about/simcity4/media_buzz.php [Online], August 2005.

[3] Electronic Arts Inc. "SIMCITY4 DELUXE EDITION (user manual)," *SIMCITY4 DELUXE EDITION*, 2003.

[4] "Tips & Tricks - Utilities," http://simcity.ea.com/tipstricks/tipstricks_utilities.php [Online], August 2005.