

# Down to the Last Drop

New Mexico Adventures in  
Supercomputing Challenge  
Final Report  
April 2, 2003

Team #34  
Farmington High School

**Team Members:**

Elizabeth Yaros  
Michael Blount Jr.  
Brian Geisthwhite  
Cynthia Douthit

**Teacher(s)**

Shirley Maurer  
Mike DeField

**Team Mentor:**

Joe Reynolds



## Table of Contents

<b>Executive Summary</b>	<b>1</b>
<b>Introduction</b>	<b>2</b>
<b>Background Information</b>	<b>2</b>
<b>Procedure</b>	<b>3</b>
<b>Results</b>	<b>7</b>
<b>Conclusions</b>	<b>8</b>
<b>Acknowledgements</b>	<b>8</b>
<b>Literature Cited</b>	<b>8</b>

**Executive Summary:** Water is one of the most abundant resources on the planet. However, this resource is slowly becoming scarce in San Juan County. With recent droughts, the problem has not improved. Slowly, our water usage will eventually exceed our water input. This is due to many various factors.

## **Introduction:**

Water has always been a concern among the citizens of the San Juan Basin. Some people believe due to population growth, the hydrological carrying capacity will be reached sooner than is expected. Our team saw our region's concern for this problem and decided to determine the severity of the threat of running out of water.

## **Background Information:**

Water and air are the most essential elements to human life. The human body can go without food for roughly 30 days, but it can only survive 3 days without water. Everyday, people use an average 115 liters of water. (San Juan Water Commission, 2002) Although all of it is not direct use, it is still a large amount of water for all the citizens in San Juan County.

Many people are confused in thinking they can use "water shortage" and "drought" interchangeably. The word "drought" means a long period with no rain, especially during a planting season. (Morris, 1969) The phrase "water shortage" means a lack of water for basic necessities such as drinking and bathing. In San Juan County, the annual precipitation is 14.26 inches. Within each month the precipitation is: January - 1.12 inches, February - 0.98 inches, March - 1.2 inches, April - 0.92 inches, May - 0.87 inches, June - 0.65 inches, July - 1.53 inches, August - 1.93 inches, September - 1.42 inches, October - 1.37 inches, November - 1.02 inches, and December - 1.13 inches. (San Juan Water Commission, 2002) In San Juan County, a drought is sometimes experienced during the summer, but the area has never has gone through a water shortage. Each year, San Juan County has 219,000,000,000 liters available a year for use. (San Juan Water Commission) Within the year though, 68% of the water is used for irrigated agriculture, 11% is gone through reservoir evaporation, 7% is available for public water supply, 2% goes to power production, and 0.8% is commercial/industrial use. (PNM, 1995) This leaves 11.2% of the available water for future use.

If a drought or a water shortage occurs, what happens? As a result of less water, some areas are not allowed to use water except for the necessities. Using the same water for more than one purpose might also be necessary. For example, a person might take a bath then use that same water to water the lawn. When the drought gets severe,

the city government's might have to help with the situation. Each different city has a different plan in case of extreme drought. In Aztec, New Mexico in the summer of 2002, the drought was so severe, the citizens were allowed to water their lawn only a few days a week, but everyone couldn't water their lawn the same day. The city officials came up with a plan to ensure everyone wouldn't water their lawn on the same day. On one day, the houses with even numbers were allowed to water their lawn, and on the next day, the houses with odd numbers were allowed to water their lawns. This and many other solutions are necessary to supply everyone enough water to everyone in times of drought.

The San Juan Basin is the source of water for the people of San Juan County. The San Juan Basin consists of nine water sheds: The Animas Watershed, the La Plata Watershed, the Middle San Juan Watershed, the Upper San Juan Watershed, the Chaco Watershed, the Blanco Canyon Watershed, the Upper San Juan above Navajo Watershed, the Mancos Watershed, and the Piedra Watershed. Uplifted areas define the boundaries of the San Juan of the San Juan Basin. The San Juan Mountains create the northern boundary, the Sierra Nacimiento creates the eastern boundary, and the Zuni and Chaska Mountains are the southern and western boundaries. The total area of the structural basin is approximately 21,600 square miles. (San Juan Water Commission, 2002)

For as long as records have been kept in the San Juan Basin and in San Juan County, a water shortage has never occurred, but a drought occurs almost every year. Many people believe a water shortage will occur within a short period of time, but with the water available each year, it will be a very long time before there are too many people and not enough water.

#### **Procedure:**

In order to begin programming, the team first gathered all equations for any factor affecting the water use in San Juan County. These included population growth, average water received, and amount of water usage per person. With these numbers, the team then created equations appropriate for each of the variables in the program. The team used this equation for population growth in San Juan County since 1980

$y = a(b^t)$  where

$a$  = the initial population of San Juan County in 1980

$b$  = 1 + the percent of growth

$t$  = the number of years after 1980.

All of the water information for San Juan County was given to the researcher in acre-feet, but the only available number for water used by a person in San Juan County was in liters. The researcher had to convert acre-feet to liters with

$$\frac{1.776 * 10^5 \text{ square feet}}{43560 \text{ square feet}} \left| \frac{7.48 \text{ gallons}}{1 \text{ cubic foot}} \right| \frac{3.785 \text{ Liters}}{1 \text{ gallon}}$$

One acre-foot of water = 1,233,262 liters.

The amount of water used per person per year in San Juan County is

$y = 42003.75$  liters

The amount of available water based on 30-year average rainfall is

$y = 2.19 * 10^{11}$

The amount of available water and the amount of water per person per year were constant. The final equation was total water usage in San Juan County, which was

$y = \text{total population} * 42003.75$

Once all these equations were ready, the researcher began to create the program. This is the program created:

```
public class Water {
    double totalpopulation = 0;
    double water = 0;
    double useage = 0;
    double years = 0;
```

```

    double t = t - 1980;
    double time = 0;
    double overage = 0;
    double year = 2002;
public void setTime(int x){
    time = x;
}
public double getWater(){
    water = 2.19*(Math.pow(10, 11));
    return water;
}
public double getPopulation(){
    totalpopulation = 81433*(Math.pow(1.011, temp));
    return totalpopulation;
}
public double getUseage(){
    useage = totalpopulation*42003.75;
    return useage;
}
public double getOverage(){
    overage = useage - water;
    return overage;
}
public double getYear(){
    year = time + 2002;
    return year;
}
}
import TerminalIO.KeyboardReader;
import BreezySwing.*;
import java.awt.*;
import javax.swing.*;
public class WaterGUI extends JFrame{
    private JLabel YearLabel;
    private IntegerField YearField;
    private JLabel PopulationLabel;
    private DoubleField PopulationField;
    private JLabel WaterLabel;

```



```
private DoubleField WaterField;
private JLabel WaterUseageLabel;
private DoubleField WaterUseageField;
private JLabel WaterOverageLabel ;
private DoubleField WaterOverageField;
private JButton CalculateButton;
Water water = new Water();
```

```
//Constructor
```

```
public WaterGUI(){
```

```
    YearLabel = addLabel ("Year: ",1,1,1,1);
    YearField = addIntegerField(0,1,2,1,1);
    CalculateButton = addButton ("Calculate",6,1,1,2);
    PopulationLabel = addLabel ("Total Population: ",2,1,1,1);
    PopulationField = addDoubleField(0,3,2,1,1);
    WaterLabel = addLabel ("Water In Liters: ",5,1,1,1);
    WaterField = addDoubleField(0,3,2,1,1);
    WaterUseageLabel = addLabel ("Water Useage In Liters:
",4,1,1,1);
    WaterUseageField = addDoubleField(0,4,2,1,1);
    WaterOverageLabel = addLabel("Water Overage In Liters:
",5,1,1,1);
    WaterOverageField = addDoubleField(0,5,2,1,1);
    PopulationField.setEditable(false);
    WaterField.setEditable(false);
    WaterUseageField.setEditable(false);
    WaterOverageField.setEditable(false);
    YearLabel.setForeground(Color.darkGray);
    YearField.setBackground(Color.darkGray);
    CalculateButton.setForeground(Color.Cyan);
    PopulationLabel.setForeground(Color.MAGENTA);
    PopulationField.setBackground(Color.MAGENTA);
    WaterLabel.setForeground(Color.blue);
    WaterField.setBackground(Color.blue);
    WaterOverageLabel.setForeground(Color.red);
    WaterOverageField.setBackground(Color.red);
    SetTitle("San Juan County - Population And Water");
```

```

}
public void buttonClicked (JButton buttonObj){
    if(buttonObj == CalculateButton){
        water.setTime((YearField.getNumber() - 2002));
        PopulationField.setNumber(water.getPopulation());
        WaterField.setNumber(water.getWater());
        WaterUsageField.setNumber(water.getUsage());
        WaterOverageField.setNumber(water.getOverage());
    }
}
public static void main(String [] args){
    WaterGUI theGUI = new WaterGUI();
    theGUI.setSize(500,750);
    theGUI.setVisible(true);
}
}

```

Once the program was completed, the researcher then used the program to calculate the hydrological carrying capacity of the San Juan Basin.

### **Results:**

When the judges from Los Alamos came to Farmington help each team, they gave this team many helpful suggestions on how to improve this project. Unfortunately, due to time constraints and limited available information, the team was unable to make some of the changes suggested. However, the Java program created calculated the hydrological carrying capacity of the San Juan Basin to be 938,250 people, which will be reached in the year 2203. However, the program assumes the population of San Juan County will continue to grow at a 1.1% annual rate, it assumes the amount of rainfall will remain constant at 14 inches a year, and it assumes the water usage by specific groups will remain the same for the next 200 years. For example, agriculture will continue to use 68% of the water; evaporation will continue to take 11%, power production will continue to use 2% and commercial/industrial use will continue to use 0.8%.

### **Conclusions:**

The team was able to create a program to calculate the hydrological carrying capacity of the San Juan Basin, but no one can be sure if the program is correct since the calculated date is 200 years away. Also, this program calculates water use based on the minimum amount of water to survive, which is 42003.75 liters a year. The team understands people generally use more for washing dishes, watering the lawn, washing the car, etc.

### **Acknowledgements:**

The team has many people to thank who helped this project come along as far as it has. First, we wish to thank Mrs. Shirley Maurer, the Farmington High School Java programming teacher for all her help and advice on how we should execute this project. Next, we thank Shaun Bishop from the San Juan County Water Commission. She helped the team by giving numbers and area history to us from the county records. The team now wishes to thank Joe Reynolds from the Los Alamos National Laboratory who offered advice and help with the team's questions. Also, we thank all the people at the expo in Glorietta who have offered help with a technical support line and have helped organize this whole competition.

### **Literature Cited:**

<http://www.pnm.com>

Katsaropolous, Chris, *Fundamentals of Java Second Edition*, Thomson Learning Inc., Boston Massachusetts, ©2003, pg. 38

Laura Lang, *Natural Resources With GIS*, ESRI, Redlands, CA, ©2000, pgs. 49-53

San Juan Water Commission, *San Juan Hydrological Unit Regional Water Plan*, San Juan County, NM, ©2002