

Cleaning Up the **Rio Grande Environment** (**CURE**)

Group 4:

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Table of Contents

Background and History.....	1
Policies and Mandates.....	3
Problems: Overview.....	4
Problem 1.....	5
Problem 2.....	6
Problem 3.....	7
Recommendations and Conclusions.....	8
References.....	9

Mission Statement:

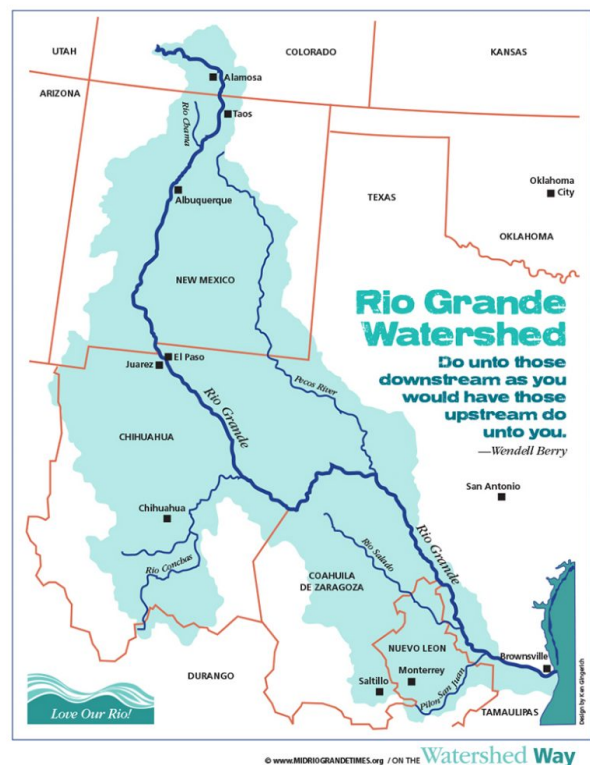
The mission of CURE is to restore the natural flow of the Rio Grande as well as reduce pollution levels by 50% by 2050 to improve the overall conditions of the Texas-Mexico portion of the river basin. While the three problems highlighted in this report are not the only issues affecting this basin, by working on them the overall quality of the Rio Grande Basin will hopefully improve.

Background and History:

The Rio Grande Basin is a critical resource to both the United States southwest and Mexico in a region routinely prone to prolonged droughts, growing populations, and industrialization. With headwaters in the San Juan Mountains in southern Colorado, the Rio Grande River winds approximately 1,900 miles to its terminus into the Gulf of Mexico, draining nearly 182,000 square miles. The river, when flowing, provides immensely for the surrounding area, consisting of three US states (Colorado, New Mexico, and Texas) and four Mexican states (Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas). Unfortunately, self-interested governing bodies and outdated and conflicting jurisdiction typically squander any opportunity to increase a unified approach to managing the Rio Grande Basin, despite how critical cooperation is to the region's vital resource.

To add to the fractured approach to management, the basin is separated into distinct reaches - The Upper Rio Grande, the Forgotten Reach, and the Lower Rio Grande. Additionally, the Pecos River parallels the Upper Rio Grande and flows through Texas until it merges with the Rio Grande along the border between Mexico and Texas.

The Upper Rio Grande has its headwaters in the San Juan Mountains in southern Colorado. The waters of the Upper Rio Grande have been stressed for decades, and the region continues to see extended droughts. Surface water shortages are common and the basin has experienced declines in groundwater levels, which further deplete surface water supplies. Downstream of Elephant Butte Reservoir, the Rio Grande only flows during irrigation water deliveries from the Rio Grande Project or in rare floods. In El Paso, water is diverted for required deliveries to Mexico. Below these diversions in El Paso, the river is typically dry, even during irrigation season, since all remaining water flows in the irrigation network. Flows support river and reservoir recreation as well as vital ecosystems and wildlife habitats. However, except in rare circumstances, the numerous water uses have fully depleted the river by the bottom of this reach.



The Forgotten Reach extends from Hudspeth County, Texas, downstream to the confluence with the Rio Conchos, which flows into the Rio Grande just upstream of Big Bend National Park. This reach, along the border between the United States and Mexico, rarely sees any flow. The remnant channel is primarily covered in invasive vegetation.

In the Lower Rio Grande, flow picks up again as the Rio Conchos flows in from Mexico just upstream of Big Bend National park. Further downstream, the International Boundary and Water Commission (IBWC) operates Amistad and Falcon Reservoirs for flood control and water supply. These international reservoirs have been designated as a special water resource by the Texas Water Development Board. About three-quarters of the watershed that feeds these international reservoirs is in Mexico. If there is sufficient water, the Rio Grande ultimately flows into the Gulf of Mexico near Brownsville, Texas.

The Pecos River flows from the Sangre De Cristo mountains through New Mexico forming a separate basin roughly parallel to the Rio Grande. This stretch mostly serves agricultural lands with some water used for municipal purposes and oil and gas extraction. The Pecos River enters the Rio Grande at Amistad Reservoir within the Lower Rio Grande in Texas.

It is evident that each reach of the basin is over-stressed. Water shortages and quality have only continued to decrease. Increasingly frequent droughts in the face of climate change and growing populations will likely exacerbate the problems already discussed. Municipal and agricultural use already claim nearly 95% of the Rio Grande's average annual flow. According to the US Bureau of Reclamation, by 2100, flows in the Rio Grande will decline in Colorado by 25%, in Central New Mexico by 35%, in southern New Mexico and Texas by more than 50%. These jarring numbers only highlight the inefficient use of water in the region, whether for agriculture, municipal and industrial, or recreation.

Concerns grow even more through the basin's lower reach along the Texas-Mexico border. Without a natural flow, fish that populate the river are stressed with increased contamination and salinity, continuously making survival more and more difficult.

It is evident the current system is broken. Local cooperation is not present and governmental policies do not have enough teeth to manage the region's dying resource. A new system is needed more than ever to help tackle the major problems confronting the river and basin.

Policies and Mandates:

Ongoing water conflicts between different jurisdictions, specifically along the Texas and Mexico border, are complicated by a multitude of legal perspectives on how to properly allocate the Rio Grande, the main water supply in the arid region. Although the effectiveness of the current policies and mandates may be up for debate, there are ample attempts to confront the problems facing the Rio Grande. Federal management includes The Bureau of Reclamation and the International Boundary and Water Commission (IBWC), which are responsible for regulating and managing water supply, reservoirs, and diversions for both water supply and flood and sediment control. The United States' Environmental Protection Agency (EPA) and Mexico's Secretariat of Environment and Natural Resources (SEMARNAT) also provide oversight to the basin and river.

In addition to federal oversight, compacts and agreements have been enacted between states to help regulate the Rio Grande Basin waters. The *Rio Grande Compact* equitably apportions flows among Colorado, New Mexico, and Texas and specifies flows based on supply from the headwaters or inflow from the next-upstream state. To assist with the Rio Grande's diminishing baseline flow, The *Upper Colorado River Compact* allows for imported water from the Colorado River.

International cooperation exists in the form of two compacts and agreements; the *1906 Convention between the United States and Mexico* and *The 1944 Water Utilization Treaty*. The 1906 Convention is the primary international agreement impacting the Upper Rio Grande reach and requires the United States to provide 60,000 acre-feet of water to Mexico at El Paso, Texas. The 1944 Water Utilization Treaty negotiates the usage of both the Colorado River and the Lower Rio Grande.

Currently, there are legal doctrines within each state and with Mexico vary on how to address hydrologically connected water supplies (i.e., surface water and groundwater). Managing these conditions along multiple state and international borders creates constant debate over responsible governing bodies and only feeds the problems that confront the Rio Grande Basin.

Problems:

Problem	Description	Causes
Water Over-Extraction	<p>Inefficient use of water for agriculture is affecting the flow of the river and surrounding basin.</p> <p>Over-Extraction also destroys the ecosystems found throughout the river.</p>	<p>Nearly 80% of Rio Grande water is used for agriculture in the U.S. and Mexico. Increase in population means more demand for agriculture results leading to a higher drain on the river basin.</p>
Pollution/Contaminants	<p>Fish near the lower portion of the Rio Grande have high levels of contaminants compared to other portions of the Rio Grande.</p> <p>Potential hazard for people and wildlife species that eat fish.</p> <p>High levels of nitrogen and phosphorus can lead to algal blooms.</p>	<p>There is roughly around 6 million gallons of raw sewage being dumped everyday.</p> <p>The Rio Grande has been polluted with municipal, industrial, agricultural and farming contaminants from both sides of the border</p>
Salinity	<p>Salinity in the Amistad Reservoir, TX, has been increasing at an annual rate of 15 - 18 mg/L from 1969 - 2004, and is likely higher now.</p>	<p>Water removal, irrigation return flows, and agricultural processes affect the salinity.</p> <p>Natural, agricultural, industrial, and urban erosional processes; all contribute to higher sediment loads and altered flow.</p> <p>Expulsion of agricultural and industrial waste directly into the subbasin.</p>

Problem 1: Water Over-Extraction

The Rio Grande River is one of the top 20 longest rivers in the world, as well as the fifth longest river that runs through the United States. Since the river is so long, it is no surprise that it provides water to over 6 million people throughout Texas and Mexico. For those 6 million people, this river is one of the main sources of both drinking water and water for agricultural use. However, the strain on the Rio Grande has become too large in the past few decades and several portions of the river run dry for months at a time.

On the U.S. side of the Rio Grande River, population has increased by 15% over the past ten years and on the Mexico side the population has nearly doubled in the past ten years. This increase in population has greatly contributed to the water over-extraction issue in the Rio Grande watershed. It has also already been projected that the need for water provided by the river will increase by over 100 percent in the next fifty years through agricultural and industrial use. The Rio Grande River is already unable to support the people who rely on it, such a large increase in demand would completely drain the river and therefore watershed.

In addition to water extraction, the vastness of the Rio Grande River leaves it open for excessive evaporation. Too much evaporation is a drain on the already struggling river and as temperatures increase every year due to climate change, evaporation can only be expected to increase.

Goal 1:

Since so many people rely on the Rio Grande River to provide them with drinking water and agricultural water, there needs to be remediation of the watershed to ensure that the river can provide for decades to come. It is unrealistic to assume that extraction can be brought down significantly because most of it is used to sustain life in the surrounding communities. Therefore, by 2050, the goal of this problem is to increase efficiency of water extraction methods and limit evaporation throughout the river to increase water levels.



Figure: As a result of over extraction, large portions of the Rio Grande River run dry. Photo by: Ivan Pierre Aguirre

Problem 2: Pollution/Contamination

Pollution comes from a variety of sources in the Rio Grande watershed. Over 5 million gallons of raw sewage is being released into the waterways each day coming from industrial, municipal, and agricultural sites. This leads to a variety of problems for the watershed and those who enjoy it, including humans and animals. Heavy metals have been found in the watershed which is harmful to the fish and the animals that eat the fish. There are currently limitations on what fish are considered safe to eat with downstream fish being more unsafe for human consumption. These heavy metals include arsenic, mercury, lead, in addition to a wide variety of other contaminants.

Raw sewage contributes large amounts of both nitrogen and phosphorus which are the two main nutrients that lead to algal blooms. These large algal blooms can cause large-scale death in fish and unsafe conditions for people to enjoy the waterways. In 2016, the Texas Parks and Wildlife Department confirmed the presence of red tide in various parts of the Rio Grande, which is very toxic to the aquatic life that inhabits the watershed. The raw sewage not only causes harm to the fish, but it's unsafe to humans who want to enjoy the waterways and provides very unpleasant smells to whomever lives downstream of the dumping locations.

Goal 2:

The goal to help reduce the amount of pollutants and contaminants from entering the watershed by 2050 is to enforce new regulations on what can be released into the waterways and better monitor to ensure that it's being reduced. Getting the communities involved to help create a better ecosystem for the animals and humans who inhabit the Rio Grande watershed.



Figure : Kayakers in Lerado, Texas where over 5 million gallons of raw sewage are released a day

Problem 3: Salinity

Because the Rio Grande is an international border between the United States of America and Mexico, it is extremely hard to regulate policy when it pertains to water use and watershed management. The watershed, and the Rio Grande in general, has been overused for industrial, natural, and agricultural processes. Water removal, irrigation return flows, and many agricultural pollutants/processes have caused the increase in salinity of the Rio Grande. In addition, the industrial processes have sped up erosion into the watershed. This contributes to higher sediment loads and altered flow.

According to the *Flows, Salts, and Trace Elements in the Rio Grande: A Review*, a report on the contaminant levels of the Rio Grande, the salinity in the Amistad Reservoir, TX, has been increasing at an annual rate of 15 - 18 mg/L from 1969 - 2004, and is likely higher now. In addition, a study done by Texas A&M University has revealed that by the time that the river reaches El Paso, Texas, the salinity is above 1,000 parts per million (ppm). This clearly indicates that the salinity in the Rio Grande, Specifically the TX-MX watershed is well above natural levels.

Due to these contributing factors, the local ecosystem has been greatly affected. The aquatic ecosystem has been altered, and many fish species have died or left the areas. In addition, the local areas are using polluted water. These are both not good for the environment, and the public.

Goal 3:

The goal includes monitoring salinity levels overtime. This can be done by quarterly testing of the salinity levels in the watershed. In addition, it is to restore the natural ecosystem of the Rio Grande by 2050; with the return of natural aquatic life.



Figure : As a result of agricultural pollution, The single-cell golden alga produces a toxin that destroys the cells of fishes' internal organs and gills, causing them to hemorrhage. Photo by: Colin McDonald

Recommendations:

To combat issues presented by Water Over-Extraction, we recommend that:

- Combined effort from the EPA (USA) and the SEMARNAT (Mexico) to create laws for all citizens to follow in regards to efficiency of water extraction.
- Research high elevation areas and invest in building deep reservoirs at those locations to hold water. This will help to limit evaporation to increase water in the watershed.

To combat issues presented by Pollution/Contamination, we recommend that:

- Plant native species and remove invasive species to reduce the nitrogen and phosphorus content in the watershed.
- Create new regulations for both the United States and Mexico to limit what can be released into the waterways to reduce pollutants and contaminants.
- Promote community clean ups to get people involved and wanting to clean up the Rio Grande.
- Monitor pollutant and nutrient levels to ensure they are being reduced.

To combat issues presented by High Salinity Levels, we recommend that:

- Combined effort from the EPA (USA) and the SEMARNAT (Mexico) to create laws that must be abided by citizens of both countries in reference to water salinity in the Rio Grande.
- Monitor groundwater levels and amount of salt in the land and water.
- Stop loss of deep rooted vegetation in high risk areas.
- Plant new vegetation, which promotes the reduction of salt in water.

Conclusion:

The Rio Grande serves communities along the Southern Border, and continuous misuse of the watersheds will be detrimental to all communities. The three problems presented earlier all interact with one another. To improve one, the others must also be improved. This will require efforts from both the EPA (USA) and SEMARNAT (Mexico) to ensure active recovery methods are being implemented. It's not too late to remediate the damage that's done and with continuous efforts, the Rio Grande will hopefully flow for generations to come.

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