# Southern Sandoval County Arroyo Flood Control Authority

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December 1, 2020

U.S. EPA, Region 6
Water Quality Protection Division
Operations Support Service (6WQ-O)
1445 Ross Avenue
Dallas, Texas 75202-2733

RE: 2020 Annual Report, NPDES Permit No. NMR04A001

To whom it may concern:

The Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) is pleased to submit the 2020 Annual Report for NPDES Permit No. NMR04A000. SSCAFCA's permit tracking number, as assigned in our letter from EPA "Coverage under Middle Rio Grande (MRG) Watershed Based Municipal Sewer Separate Storm Sewer System General Permit (NPDES No. NMR04A000) is NMR04A001. This report covers the period from July 1, 2019 (the date of the letter from EPA authorizing coverage under NPDES Permit No. NMR04A000) to June 30, 2020.

Materials contained within this transmittal include our Annual Report compiled using the EPA's suggested Annual Report Format, a 2020 Annual Report Supplement, the volume of trash removed from SSCAFCA-owned facilities, the volume of sediment removed from SSCAFCA's facilities, the Arroyo Classroom 2020 report, the River Xchange 2020 report, the Summary of Outcomes Report for the Mid Rio Grande Stormwater Quality Team, a summary of dry weather sampling for eColi completed by BEMP during the reporting period, and a memorandum developed on behalf of the Compliance Monitoring Cooperative for discussing the status of compliance monitoring for this permit. A copy of the memorandum of understanding between SSCAFCA and AMAFCA as well as the letter from EPA authorizing this action are included in this report.

If you have any further questions, please feel free to contact David Gatterman at dgatterman@sscafca.com or at 505-892-7246.

Sincerely,

Charles Thomas, PE
Executive Engineer
SSCAFCA

# 2020 Annual Report
# Reporting Period – July 1, 2019 – June 30, 2020

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# Annual Report Format

**National Pollutant Discharge Elimination System Stormwater Program**
**MS4 Annual Report Form**

Check box if you are submitting an individual Annual Report with cooperative program elements ☒

Check box if you are submitting an individual Annual Report with individual program elements ☐

Check box if this is a new name, address, etc. ☐

## 1. MS4(s) Information

Southern Sandoval County Arroyo Flood Control Authority
Name of MS4

David | Gatterman | Facility Operations Director
Name of Contact Person (First) (Last) (Title)

505-892-7246 | dgatterman@sscafca.com
Telephone (including area code) E-mail

1041 Commercial Dr. SE
Mailing Address

Rio Rancho | NM | 87124
City State ZIP code

What size population does your MS4(s) serve? 101,103 NPDES number

What is the reporting period for this report? (mm/dd/yyyy) From Jul 1, 2019 to Jun 30, 2020

## 2. Water Quality Priorities

A. Does your MS4(s) discharge to waters listed as impaired on a state 303(d) list? ☒ Yes ☐ No

B. If yes, identify each impaired water, the impairment, whether a TMDL has been approved by EPA for each, and whether the TMDL assigns a wasteload allocation to your MS4(s). Use a new line for each impairment, and attach additional pages as necessary.

| Impaired Water | Impairment | Approved TMDL | | TMDL assigns WLA to MS4 | |
|---|---|---|---|---|---|
| Rio Grande, HUC 13020203 | eColi | ☒ Yes | ☐ No | ☒ Yes | ☐ No |
| Rio Grande, HUC 13020203 | PCB in fish tissue | ☐ Yes | ☒ No | ☐ Yes | ☒ No |
| Rio Grande, HUC 13020203 | PCB in water column | ☐ Yes | ☒ No | ☐ Yes | ☒ No |
| Rio Grande, HUC 13020203 | Gross Alpha | ☐ Yes | ☒ No | ☐ Yes | ☒ No |

**2. B. Continued**

| Impaired Water | Impairment | Approved TMDL | TMDL assigns WLA to MS4 |
|---|---|---|---|
| | | ☐ Yes ☐ No | ☐ Yes ☐ No |
| | | ☐ Yes ☐ No | ☐ Yes ☐ No |
| | | ☐ Yes ☐ No | ☐ Yes ☐ No |
| | | ☐ Yes ☐ No | ☐ Yes ☐ No |

C. What specific sources contributing to the impairment(s) are you targeting in your stormwater program?

Pet waste, floatables, illicit discharges

D. Do you discharge to any high-quality waters (e.g., Tier 2, Tier 3, outstanding natural resource waters, or other state or federal designation)? ☐ Yes ☒ No

E. Are you implementing additional specific provisions to ensure their continued integrity? ☐ Yes ☒ No

**3. Public Education and Public Participation**

A. Is your public education program targeting specific pollutants and sources of those pollutants? ☒ Yes ☐ No

B. If yes, what are the specific sources and/or pollutants addressed by your public education program?

Pet waste, floatables, illicit discharges

C. Note specific successful outcome(s) (e.g., quantified reduction in fertilizer use; NOT tasks, events, publications) fully or partially attributable to your public education program during this reporting period.

See outcomes report from the Middle Rio Grande Storm Water Quality Team

D. Do you have an advisory committee or other body comprised of the public and other stakeholders that provides regular input on your stormwater program? ☐ Yes ☒ No

**4. Construction**

A. Do you have an ordinance or other regulatory mechanism stipulating:

Erosion and sediment control requirements? ☒ Yes ☐ No

Other construction waste control requirements? ☒ Yes ☐ No

Requirement to submit construction plans for review? ☒ Yes ☐ No

MS4 enforcement authority? ☒ Yes ☐ No

B. Do you have written procedures for:

Reviewing construction plans? ☒ Yes ☐ No

Performing inspections? ☒ Yes ☐ No

Responding to violations? ☒ Yes ☐ No

C. Identify the number of active construction sites ≥ 1 acre in operation in your jurisdiction at any time during the reporting period. 3

D. How many of the sites identified in 4.C did you inspect during this reporting period? 3

E. Describe, on average, the frequency with which your program conducts construction site inspections.

All SSCAFCA-owned sites are inspected by SSCAFCA personnel at a minimum weekly. Qualified contractors inspect the

F. Do you prioritize certain construction sites for more frequent inspections? ☐ Yes ☒ No

If Yes, based on what criteria? All SSCAFCA-owned sites are inspected

G. Identify which of the following types of enforcement actions you used during the reporting period for construction activities, indicate the number of actions, or note those for which you do not have authority:

| | | | | |
|---|---|---|---|---|
| ☐ Yes | Notice of violation | | No Authority | ☒ |
| ☐ Yes | Administrative fines | | No Authority | ☒ |
| ☐ Yes | Stop Work Orders | | No Authority | ☒ |
| ☐ Yes | Civil penalties | | No Authority | ☒ |
| ☐ Yes | Criminal actions | | No Authority | ☒ |
| ☐ Yes | Administrative orders | | No Authority | ☒ |
| ☒ Yes | Other | Contractual mechanisms fo | | |

H. Do you use an electronic tool (e.g., GIS, data base, spreadsheet) to track the locations, inspection results, and enforcement actions of active construction sites in your jurisdiction? ☐ Yes ☒ No

I. What are the 3 most common types of violations documented during this reporting period?

No violations noted. SSCAFCA has stop work authority on SSCAFCA-owned projects

J. How often do municipal employees receive training on the construction program? As needed

## 5. Illicit Discharge Elimination

A. Have you completed a map of all outfalls and receiving waters of your storm sewer system? ☒ Yes ☐ No

B. Have you completed a map of all storm drain pipes and other conveyances in the storm sewer system? ☒ Yes ☐ No

C. Identify the number of outfalls in your storm sewer system. 8

D. Do you have documented procedures, including frequency, for screening outfalls? ☒ Yes ☐ No

E. Of the outfalls identified in 5.C, how many were screened for dry weather discharges during this reporting period?

8

F. Of the outfalls identified in 5.C, how many have been screened for dry weather discharges at any time since you obtained MS4 permit coverage? 8

G. What is your frequency for screening outfalls for illicit discharges? Describe any variation based on size/type.

All SSCAFCA facilities are inspected at a minimum twice per year (pre and post monsoon) for a condition of facility asse

H. Do you have an ordinance or other regulatory mechanism that effectively prohibits illicit discharges? ☐ Yes ☒ No

I. Do you have an ordinance or other regulatory mechanism that provides authority for you to take enforcement action and/or recover costs for addressing illicit discharges? ☐ Yes ☒ No

J. During this reporting period, how many illicit discharges/illegal connections have you discovered? 1

K. Of those illicit discharges/illegal connections that have been discovered or reported, how many have been eliminated? 1

L. How often do municipal employees receive training on the illicit discharge program? As needed

## 6. Stormwater Management for Municipal Operations

A. Have stormwater pollution prevention plans (or an equivalent plan) been developed for:

| | | |
|---|---|---|
| All public parks, ball fields, other recreational facilities and other open spaces | ☐ Yes | ☒ No |
| All municipal construction activities, including those disturbing less than 1 acre | ☐ Yes | ☒ No |
| All municipal turf grass/landscape management activities | ☐ Yes | ☒ No |
| All municipal vehicle fueling, operation and maintenance activities | ☐ Yes | ☒ No |
| All municipal maintenance yards | ☐ Yes | ☒ No |
| All municipal waste handling and disposal areas | ☐ Yes | ☒ No |

Other

B. Are stormwater inspections conducted at these facilities? ☐ Yes ☒ No

C. If Yes, at what frequency are inspections conducted? NA

D. List activities for which operating procedures or management practices specific to stormwater management have been developed (e.g., road repairs, catch basin cleaning).

Pre and post monsoon inspection and cleaning of flood control facilities

E. Do you prioritize certain municipal activities and/or facilities for more frequent inspection? ☒ Yes ☐ No

F. If Yes, which activities and/or facilities receive most frequent inspections? Dams, ponds, sediment control facilities

G. Do all municipal employees and contractors overseeing planning and implementation of stormwater-related activities receive comprehensive training on stormwater management? ☒ Yes ☐ No

H. If yes, do you also provide regular updates and refreshers? ☒ Yes ☐ No

I. If so, how frequently and/or under what circumstances? All technical staff are encouraged to seek training on stor

## 7. Long-term (Post-Construction) Stormwater Measures

A. Do you have an ordinance or other regulatory mechanism to require:

| | | |
|---|---|---|
| Site plan reviews for stormwater/water quality of all new and re-development projects? | ☒ Yes | ☐ No |
| Long-term operation and maintenance of stormwater management controls? | ☒ Yes | ☐ No |
| Retrofitting to incorporate long-term stormwater management controls? | ☒ Yes | ☐ No |

B. If you have retrofit requirements, what are the circumstances/criteria?

For all SSCAFCA-owned projects, all site plan reviews

C What are your criteria for determining which new/re-development stormwater plans you will review (e.g., all projects, projects disturbing greater than one acre, etc.)?

All SSCAFCA-owned projects are reviewed.

D. Do you require water quality or quantity design standards or performance standards, either directly or by reference to a state or other standard, be met for new development and re-development? ☒ Yes ☐ No

E. Do these performance or design standards require that pre-development hydrology be met for:

| | | |
|---|---|---|
| Flow volumes | ☐ Yes | ☒ No |
| Peak discharge rates | ☒ Yes | ☐ No |
| Discharge frequency | ☐ Yes | ☒ No |
| Flow duration | ☐ Yes | ☒ No |

F. Please provide the URL/reference where all post-construction stormwater management standards can be found.

Watershed management plans are located at: http://sscafca.org/watershed-and-drain-management-plans/

G. How many development and redevelopment project plans were reviewed during the reporting period to assess impacts to water quality and receiving stream protection?

H. How many of the plans identified in 7.G were approved?

I. How many privately owned permanent stormwater management practices/facilities were inspected during the reporting period? 0

J. How many of the practices/facilities identified in I were found to have inadequate maintenance? 0

K. How long do you give operators to remedy any operation and maintenance deficiencies identified during inspections? NA

L. Do you have authority to take enforcement action for failure to properly operate and maintain stormwater practices/facilities? ☐ Yes ☒ No

M. How many formal enforcement actions (i.e., more than a verbal or written warning) were taken for failure to adequately operate and/or maintain stormwater management practices? 0

N. Do you use an electronic tool (e.g., GIS, database, spreadsheet) to track post-construction BMPs, inspections and maintenance? ☒ Yes ☐ No

O. Do all municipal departments and/or staff (as relevant) have access to this tracking system? ☒ Yes ☐ No

P. How often do municipal employees receive training on the post-construction program? As needed

## 8. Program Resources

A. What was the annual expenditure to implement MS4 permit requirements this reporting period? 67127

B. What is next year's budget for implementing the requirements of your MS4 NPDES permit? 111375

C. This year what is/are your source(s) of funding for the stormwater program, and annual revenue (amount or percentage) derived from each?

| Source: | Amount $ | OR % |
|---|---|---|
| Property tax mil levy | | 100 |
| | | |
| | | |

D. How many FTEs does your municipality devote to the stormwater program (specifically for implementing the stormwater program; not municipal employees with other primary responsibilities)? 1.5

E. Do you share program implementation responsibilities with any other entities? ☐ Yes ☐ No

| Entity | Activity/Task/Responsibility | Your Oversight/Accountability Mechanism |
|---|---|---|
| See Attached | Storm Water Quality Team | Signed agreement |
| See Attached | Compliance Monitoring Cooperative | Signed agreement |
| See Attached | Technical Advisory Group | Signed agreement |

## 9. Evaluating/Measuring Progress

A. What indicators do you use to evaluate the overall effectiveness of your stormwater management program, how long have you been tracking them, and at what frequency? These are not measurable goals for individual management practices or tasks, but large-scale or long-term metrics for the overall program, such as macroinvertebrate community indices, measures of effective impervious cover in the watershed, indicators of in-stream hydrologic stability, etc.

| Indicator | Began Tracking (year) | Frequency | Number of Locations |
|---|---|---|---|
| *Example:* E. coli | 2003 | Weekly April–September | 20 |
| Various (EPA approved analyte list) | 2016 | Qualifying Events (up to 7) | 2 |
| Various (EPA approved analyte list) | 2014 | Wet season, anually | 8 |
| Please refer to attached Annual Report | | | |
| or SSCAFCA website for additional | | | |
| information | | | |

B. What environmental quality trends have you documented over the duration of your stormwater program? Reports or summaries can be attached electronically, or provide the URL to where they may be found on the Web.

## 10. Additional Information

Please attach any additional information on the performance of your MS4 program, including information required in Parts I.C and III.B. If providing clarification to any of the questions on this form, please provide the question number (e.g., 2C) in your response.

### Certification Statement and Signature

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. ☐ Yes ☐ No

Federal regulations require this application to be signed as follows: **For a municipal, State, Federal, or other public facility**: by either a principal executive or ranking elected official.

Signature

Name of Certifying Official, Title

Date (mm/dd/yyyy)

October 5, 2020

**2020 Annual Report Supplement (Reporting period 7/1/19 – 6/30/20)**
**NPDES Permit NMR04A001**
**Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA)**

This document is being provided as a supplement to the form that was provided by the EPA as the format for the Annual Report. The supplement is being used to provide more explanation to responses provided in the Annual Report form where specific circumstances of SSCAFCA's status require more information to be provided than is allowed on the form. Additionally, responses to permit required

**Section 1, NPDES Number:** The pdf form provided by the EPA does not allow for non-numeric data entry in this field. The NPDES number for our permit is NMR04A001

**Section 4.A**, "Do you have an ordinance or other regulatory mechanism stipulating: erosion control requirements; other construction waste control requirements; requirement to submit construction plans for review; and, MS4 enforcement authority?"

> *Response:* On the form, SSCAFCA has indicated "yes" to all of these program elements. It should be noted that SSCAFCA only has jurisdictional authority over SSCAFCA-owned projects. The indication of "yes" on the Annual Report shall be in the context of SSCAFCA-owned projects only.

**Section 4.B**, "Do you have written procedures for: reviewing construction plans; performing inspections; and, responding to violations?"

> *Response:* On the form, SSCAFCA has indicated "yes" to all of these program elements. It should be noted that SSCAFCA only has jurisdictional authority over SSCAFCA-owned projects. The indication of "yes" on the Annual Report shall be in the context of SSCAFCA-owned projects only.

**Section 4.C**, "Identify the number of active construction sites > 1 acre in operation in your jurisdiction at any time during the reporting period"

> *Response:* The number indicated in the provided box is the number of active SSCAFCA construction projects during the reporting year. Since SSCAFCA does not have jurisdictional authority over private development, that type of activity is not covered in our reporting of active construction sites.

**Section 4.F**, "Do you prioritize certain construction sites for more frequent inspections?"

> *Response:* On the form, SSCAFCA has indicated "no" to this program element. Since SSCAFCA only has jurisdiction over SSCAFCA-owned projects, SSCAFCA inspects these projects with the same priority.

**Section 4.H**, "Do you use an electronic tool (e.g. GIS, data base, spreadsheet) to track locations, inspection results, and enforcement actions of active construction sites in your jurisdiction?"

> *Response:* On the form, SSCAFCA has indicated "no" to this program element. Since SSCAFCA only has jurisdiction over SSCAFCA-owned projects and since there are relatively few of these projects underway at any one time, the usage of an electronic means of tracking was deemed to be not necessary and would provide more burden than assistance with regard to tracking these program items.

**Section 4.I,** "What are the 3 most common types of violations documented during the reporting period?"

*Response:* During the reporting period, SSCAFCA had three active SSCAFCA-owned construction projects. This project was inspected by SSCAFCA personnel and contractor personnel frequently and no violations were identified during the project.

**Section 6.A,** "Have stormwater pollution prevention plans (or an equivalent plan) been developed for: All public parks, ball fields, other recreational facilities and other open spaces; all municipal construction activities including those disturbing less than 1 acre; all municipal turf grass/landscape management activities; all municipal vehicle fueling, operation, and maintenance activities; all municipal maintenance yards; and all municipal waste handling and disposal areas?"

*Response:* On the form, SSCAFCA has indicated "no" to these program elements. SSCAFCA does not currently own or operate any of the types of facilities indicated in the Annual Report form.

**Section 6.B**, "Are stormwater inspections conducted at these facilities?"

*Response:* On the form, SSCAFCA has indicated "no" to this program element. Since SSCAFCA does not own or operate any of these facility types, no inspections have occurred.

**Section 7.A,** "Do you have an ordinance or other regulatory mechanism to require: Site plan reviews for stormwater/water quality of all new and re-development projects; long-term operation and maintenance of stormwater management controls; retrofitting to incorporate long-term stormwater management criteria?"

*Response:* On the form, SSCAFCA has indicated "yes" on all program elements. SSCAFCA does not have jurisdiction outside of SSCAFCA-owned projects. SSCAFCA does have internal polices directing staff with regard to the program elements. However, SSCAFCA does participate in some plan reviews with the City of Rio Rancho for those developments that may impact SSCAFCA facilities. During this annual report year, SSCAFCA reviewed 22 development plans meeting these criteria and identified Low Impact Development opportunities for six of these plans.

**Section 7.D,** "Do you require water quality or quantity design standards or performance standards, either directly or by reference to a state or other standard, be met for new development and re-development?"

*Response:* On the form, SSCAFCA has indicated "yes" on this program element. On SSCAFCA-owned projects, SSCAFCA is required by State Law, to abide by the 96 hour rule, requiring all flood control facilities to discharge all detained stormwater within 96 hours. Therefore, all SSCAFCA flood control projects drain within 96 hours.

**Section 7.E,** "Do these performance or design standards require that pre-development hydrology be met for: flow volumes; peak discharge rates; discharge frequency; and, flow duration?"

*Response:* On the form, SSCAFCA has indicated "no" on all program elements except for Peak

Discharge Rates. SSCAFCA-owned projects are flood control projects that generate little to no excess stormwater on site as the vast majority (>99%) of these projects are not constructed from impermeable materials. These projects are constructed to manage up-stream flows from development and attenuate the hydrograph so that stormwater can be conveyed safely through downstream facilities. However, SSCAFCA-owned projects are designed to provide for attenuation of stormwater hydrographs from upstream and discharge at historical levels to the greatest extent practicable.

**Section 7.G,** "How many development and redevelopment project plans were reviewed during the reporting period to assess impacts to water quality and receiving stream protection?"

*Response:* SSCAFCA reviews development plans in conjunction with the City of Rio Rancho. No assessment of impacts to water quality due to development are not required by the City of Rio Rancho and SSCAFCA does not have regulatory authority to require these. The number indicated is the number of plans that was reviewed by SSCAFCA during the reporting year.

**Section 7.H**, "How many of the plans identified in 7.G were approved?

*Response:* SSCAFCA does not have authority to approve or not approve development plans.

**Section 7.I**, "How many privately owned permanent stormwater management practices/facilities were inspected during the reporting period?"

*Response:* On the form, SSCAFCA has indicated "0" for this program element. SSCAFCA does not have statutory authority to regulate private development, including regulation of post-development conditions.

**Section 7.J,** "How many practices/facilities identified in I were found to have inadequate maintenance?"

*Response:* On the form, SSCAFCA has indicated "0" for this program element. SSCAFCA does not have statutory authority to regulate private development or post-construction conditions in private development. However, SSCAFCA facilities inspected for routine maintenance during the reporting cycle had maintenance needs identified and carried out.

**Section 7.L,** "Do you have authority to take enforcement action for failure to property operate and maintain stormwater practices/facilities?"

*Response:* On the form, SSCAFCA has indicated "No" for this program element. SSCAFCA does not have statutory authority to regulate private development or post-construction conditions in private development.

**Section 7.N,** "Do you use an electronic tool (e.g. GIS, database, spreadsheet) to track post-construction BMPs, inspections, and maintenance?"

*Response:* On the form, SSCAFCA has indicated "Yes" for this program element. SSCAFCA uses a spreadsheet for reporting maintenance activities to the U.S. Army Corps of Engineers (USACE) as part of the Letter of Permission for maintenance work within the Waters of the United States. SSCAFCA facilities are, for the most part, considered Waters of the United States by the USACE.

SSCAFCA also uses electronic inspection forms and a database on maintenance activities for SSCAFCA-owned facilities.

**Section 8.A,** "What was the annual expenditure to implement the MS4 permit requirements this reporting period?"

*Response:* On the form, SSCAFCA has indicated a value of $67,127. This funding went toward, dues to the Stormwater Quality Team, expenditures for operating the Arroyo Classroom program in Sandoval County through Cuidad Soil and Water Conservation District, SSCAFCA's contribution to the Compliance Monitoring Cooperative, funding for Senior Citizen outreach program (aka Watershed Stewards), sponsorship of the Xeriscape conference in Albuquerque, purchase or "Poop Fairy" signs, and sponsorship of the Children's Water Festival in Rio Rancho.

**Section 8.B,** "What is next year's budget for implementing the requirements of your MS4 NPDES permit?"

*Response:* On the form, SSCAFCA has indicated a value of $111,375. This amount does not include salaries for personnel working on permit compliance issues. There are no projected capital outlay projects targeted at stormwater quality during the 2020-2021 reporting year, hence the reduced number.

October 5, 2020

Report on trash collected from SSCAFCA facilities placeholder

| Facility ID | Watershed | Faclity Name | Latitude | Longitude | Size of Structure (ac) | Length of channels (LF) | Sediment Capacity (CYDS) | Sediment Removed (2019) | Sediment Removal on Earthen Structures | Sediment Removal on Concrete Structures | Erosion Repair and Control | Concrete Repairs | Vegetation Removal/ Management | Manual Trash Removal | Vactor Cleaning | Access Control | Slide Gate Servicing | Water Monitoring | WQ Structure Cleaning | Bank Restoration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BL_P0003 | Black Arroyo | Gateway Pond | 35.220651 | -106.696681 | 5.65 | | 800-1200 | | X | | X | X | X | X | | X | | | | X |
| BL_P0004 | Black Arroyo | Tract 17 Pond | 35.229243 | -106.689473 | 15.9 | | 20000 | | X | | X | X | X | X | | X | | | | X |
| BL_P0006 | Black Arroyo | Sugar Channel | 35.251406 | -106.709973 | 1.09 | 3180 | 3000 | | X | | X | | X | X | | | | | | X |
| BL_P0008 | Black Arroyo | East Branch Cabezon Channel | 35.225510 | -106.682751 | 1.4 | 1700 | 40800 | | | X | | X | X | X | | X | | | | |
| BL_P0009 | Black Arroyo | Trevino Channel (Golf Course to Nicklaus Park) | 35.244348 | -106.682540 | 3.79 | 1560 | 8500 | | X | | X | | X | X | | | | | | X |
| BL_P0013 | Black Arroyo | Sunset Pond & Aldaba Storm Drain | 35.261292 | -106.711816 | 5.2 | | 17600 | | X | | X | | X | X | | X | | | | X |
| BL_P0014 | Black Arroyo | Ivory Channel | 35.243570 | -106.713069 | 0.45 | 1322 | 13872 | | | X | | X | X | | | | | | | |
| BL_P0015 | Black Arroyo | Stallion Channel (powerline easement to Weste | 35.251489 | -106.690107 | 5.46 | 2779 | 12000 | 110 | X | | X | | X | X | | | | | | X |
| BL_P0016 | Black Arroyo | Stallion Channel (Western Hills to Nicklaus) | 35.243476 | -106.685574 | 8.7 | 3000 | 20000 | 1221 | X | | X | | X | X | | | | | | X |
| BL_P0020 | Black Arroyo | West Nicklaus Channel (Bogie to Lema) | 35.252091 | -106.684151 | 0.94 | 1100 | 2500 | | X | | X | | X | X | | | | | | X |
| BL_P0021 | Black Arroyo | West Nicklaus Channel (Lema to Fairway) | 35.249020 | -106.684741 | 1.11 | 1233 | 2600 | | X | | X | | X | X | | | | | | X |
| BL_P0022 | Black Arroyo | West Nicklaus Channel (Fairway to Casper) | 35.245777 | -106.683746 | 0.94 | 1070 | 2500 | | X | | X | | X | X | | | | | | X |
| BL_P0028 | Black Arroyo | West Branch Cabezon Channel | 35.219805 | -106.686956 | 14.4 | 4650 | 46000 | | | X | | X | X | X | | X | | | | |
| BL_P0029 | Black Arroyo | Arkansas Channel | 35.248559 | -106.714724 | 1.03 | 4000 | 1800 | | X | | X | | X | X | | | | | | X |
| BL_P0030 | Black Arroyo | Rodeo Channel | 35.244514 | -106.718362 | 0.66 | 2860 | 1200 | | X | | X | | X | X | | | | | | X |
| BL_P0031 | Black Arroyo | Pecos Channel | 35.242861 | -106.715212 | 0.45 | 1950 | 900 | | X | | X | | X | X | | | | | | X |
| BL_P0032 | Black Arroyo | Baltic Channel | 35.249277 | -106.714133 | 0.56 | 2450 | 1100 | | X | | X | | X | X | | | | | | X |
| BL_P0033 | Black Arroyo | Bali Channel | 35.252893 | -106.713577 | 0.26 | 1130 | 600 | | X | | X | | X | X | | | | | | X |
| BL_P0034 | Black Arroyo | Spur Channel | 35.242249 | -106.708942 | 0.31 | 578 | 750 | 55 | | X | X | X | X | X | | | | | | X |
| BL_P0035 | Black Arroyo | Lisbon Channel (Tulip to Tarpon) | 35.255490 | -106.703876 | 1.48 | 4300 | 5500 | | X | | X | | X | X | | X | | | | X |
| BL_P0036 | Black Arroyo | Lisbon Channel (Tarpoon to Southern) | 35.245675 | -106.708782 | 1.7 | 4930 | 6000 | | X | | X | | X | X | | X | | | | X |
| BL_P0037 | Black Arroyo | Lisbon Channel (Southern to Black Arroyo Trail E | 35.240557 | -106.703944 | 1.16 | 1262 | 4000 | | X | | X | | X | X | | X | | | | X |
| BL_P0038 | Black Arroyo | Black Arroyo Wildlife Park | 35.233904 | -106.700376 | 77.88 | | 70000 | | | | X | | X | X | | X | | | | |
| BL_P0039 | Black Arroyo | Landing Trail Pond | 35.260668 | -106.717698 | 0.91 | | 3000 | | X | | X | | X | X | | X | | | | |
| CA_P0008 | Callabacillas | Redwood Pond | 35.242594 | -106.739582 | 0.61 | | 980 | | X | | X | | X | X | | X | | | | X |
| CO_P0002 | Coronado | Bosque de Bernalillo Water Quality Facility | 35.319993 | -106.563053 | 0.25 | | 300 | | X | | X | | X | X | | X | | | | X |
| CO_P0005 | Coronado | Joiner Pond Unit 20 Industrial Park | 35.321786 | -106.570976 | 5.74 | | 400 | | | X | X | X | X | X | | X | | | | |
| CW_P0009 | Corrales | Lower Tree Farm Pond | 35.222049 | -106.641367 | 1.57 | | 800 | | X | | X | | X | X | | X | | | | |
| CW_P0010 | Corrales | Upper Tree Farm Pond | 35.226728 | -106.650958 | 1.01 | | 600 | | X | | X | | X | X | | X | | | | |
| CW_P0011 | Corrales | Urban Pond - Stephanie Rd | 35.234689 | -106.652281 | 0.95 | | 600 | | X | | X | | X | X | | X | | | | |
| CW_P0012 | Corrales | Upper Urban Pond | 35.233181 | -106.646225 | 6.63 | | 1200 | | X | | X | | X | X | | X | | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CW_P0013 | Corrales | Lower Urban Pond | 35.226974 | -106.636145 | 0.79 | | 600 | | X | | X | | X | X | | X | | | |
| BA_P0016 | La Barranca | Campus Dam aka Upper SLO Dam | 35.320872 | -106.685623 | 24 | | 20000 | | X | | X | X | X | X | | X | | | X |
| MO_P0002 | Montoyas | Sportsplex Dam | 35.259111 | -106.666789 | 33.48 | | 44500 | | X | | X | X | X | X | | X | | | X |
| MO_P0012 | Montoyas | Harvey Jones Channel Corrales Rd to River | 35.260526 | -106.598557 | 6.98 | 5067 | 77450 | | X | X | X | X | X | X | | X | | | |
| MO_P0015 | Montoyas | Corrales Heights Dam | 35.249818 | -106.635630 | 35 | | 15000 | | X | X | X | X | X | X | | X | | | X |
| MO_P0017 | Montoyas | Lomitas Negras NM528 to DCC Inlet | 35.271609 | -106.613651 | 28 | | 45673 | 31248 | X | X | X | X | X | X | | X | | | X |
| MO_P0021 | Montoyas | Lower Montoyas water quality facility | 35.256684 | -106.617011 | 35000 | 30 | 66000 | 22187 | X | X | X | X | X | X | | X | | | |
| MO_P0029 | Montoyas | Lower Montoyas Water Quality Facility to NM 5 | 35.256494 | -106.629590 | 8.91 | 2155 | 70000 | | X | | X | | X | X | | X | | | X |
| MO_P0036 | Montoyas | Ponce de Leon trib Montoyas Arroyo to Progres | 35.322955 | -106.717630 | 67.3 | | 70000 | | | X | X | X | X | X | | | | | |
| MO_P0037 | Montoyas | Dulcelina Curtis Channel | 35.260966 | -106.613483 | 2.33 | 5088 | 38100 | | | X | | X | | X | | X | | | |
| MO_P0039 | Montoyas | Northern Blvd Sedimentation Basin | 35.274924 | -106.688748 | 4.56 | | 23000 | | X | | X | | X | X | | | | | |
| MO_P0040 | Montoyas | Harvey Jones Channel Inlet to Corrales Rd | 35.256798 | -106.613094 | 8.06 | | 39000 | | | X | | X | | X | | X | | | |
| MO_P0041 | Montoyas | Sierra Norte Channel North Hills | 35.281164 | -106.699006 | 0.62 | 1350 | 2000 | | X | X | X | X | X | X | | X | | | X |
| MO_P0042 | Montoyas | Acadia Court Pond | 35.259117 | -106.671311 | 1.2 | | 1900 | | X | | X | | X | X | | X | | | |
| MO_P0043 | Montoyas | Loma Pinon Loop Pond | 35.284188 | -106.717072 | 0.33 | | 530 | | X | | X | | X | X | | X | | | |
| MO_P0044 | Montoyas | Lark Pond High Range Subdivision | 35.289114 | -106.662772 | 0.98 | | 1600 | | X | | X | | X | X | | X | | | |
| MO_P0045 | Montoyas | Sundt Pond | 35.258251 | -106.642470 | 2.57 | | 2500 | | X | | X | | X | X | | X | | | |
| MO_P0046 | Montoyas | Pam's Pond | 35.250144 | -106.631979 | 0.26 | | 1200 | | X | | X | | X | X | | X | | | |
| MO_P0047 | Montoyas | Pond 116 | 35.250102 | -106.634471 | 1.61 | | 800 | | X | | X | X | X | X | | X | | | |
| MO_P0048 | Montoyas | Cielo Norte Pond and Outfall Michelle Dr Pond | 35.299483 | -106.712313 | 1.03 | | 850 | | X | | X | X | X | X | | X | | | X |
| MO_P0049 | Montoyas | Wilpett Pond 1 Northern Meadows | 35.323468 | -106.711123 | 2.37 | | 2500 | | X | | X | | X | X | | X | | | |
| MO_P0050 | Montoyas | Wilpett Pond 2 Northern Meadows | 35.321380 | -106.710509 | 1.5 | | 1200 | | X | | X | | X | X | | X | | | |
| MO_P0051 | Montoyas | Wilpett Pond 3 Northern Meadows | 35.320616 | -106.710077 | 2.52 | | 2700 | | X | | X | | X | X | | X | | | |
| MO_P0052 | Montoyas | Wilpett Pond 4 Northern Meadows | 35.318456 | -106.708595 | 2.22 | | 2500 | | X | | X | | X | X | | X | | | |
| MO_P0053 | Montoyas | Wilpett Pond 5 Northern Meadows | 35.316833 | -106.707385 | 2.51 | | 2500 | | X | | X | | X | X | | X | | | |
| MO_P0054 | Montoyas | Wilpett Pond 6 Northern Meadows | 35.315284 | -106.707316 | 4.98 | | 5000 | | X | | X | | X | X | | X | | | |
| MO_P0055 | Montoyas | Clear Creek Pond Northern Meadows | 35.315695 | -106.715154 | 1.6 | | 800 | | X | | X | | X | X | | X | | | |
| MO_P0056 | Montoyas | Desert Willow Pond Northern Meadows | 35.321171 | -106.714204 | 2.36 | | 1600 | | X | | X | | X | X | | X | | | |
| MO_P0057 | Montoyas | Flat Iron Pond Northern Meadows | 35.313492 | -106.714876 | 3.22 | | 1800 | | X | | X | | X | X | | X | | | |
| MO_P0058 | Montoyas | Havasua Falls Pond Northern Meadows | 35.316248 | -106.713345 | 1.18 | | 1500 | | X | | X | | X | X | | X | | | |
| MO_P0059 | Montoyas | James Road Pond Northern Meadows | 35.322175 | -106.720300 | 1.22 | | 1500 | | X | | X | | X | X | | X | | | |
| MO_P0060 | Montoyas | Sunny Meadows Pond | 35.318801 | -106.720709 | 1.18 | | 800 | | X | | X | | X | X | | X | | | |
| MO_P0061 | Montoyas | 28th Ave Pond | 35.307022 | -106.709698 | 1 | | 4800 | | X | | X | | X | X | | X | | | |
| MO_P0062 | Montoyas | King Blvd Pond Northern Meadows | 35.312955 | -106.711838 | 5 | | 5500 | | X | | X | | X | X | | X | | | |
| MO_P0063 | Montoyas | Marlow Meadows Pond | 35.307913 | -106.712119 | 4.7 | | 22700 | | X | | X | | X | X | | X | | | |
| MO_P0064 | Montoyas | Tin Cup Pond | 35.311663 | -106.713648 | 3.4 | | 16000 | | X | | X | | X | X | | X | | | |
| MO_P0066 | Montoyas | Ocotillo Hills East Pond | 35.267900 | -106.677953 | 0.15 | | 500 | | X | | X | | X | X | | X | | | |
| MO_P0067 | Montoyas | Ocotillo Hills West Pond | 35.267908 | -106.678527 | 0.17 | | 550 | | X | | X | | X | X | | X | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MO_P0069 | Montoyas | 4 to 1 Pipeline | 35.245495 | -106.636559 | 0.46 | 3354 | 750 | | | X | | X | | X | | X | | | |
| MO_P0071 | Montoyas | Walter Road Pond | 35.322201 | -106.723567 | 4.15 | | 13400 | | X | | X | | X | X | | X | | | |
| MO_P0072 | Montoyas | 26th Ave Pond | 35.302387 | -106.712152 | 1 | | 3200 | | X | | X | | X | X | | X | | | |
| MO_P0073 | Montoyas | 25th Ave Pond | 35.300723 | -106.712281 | 0.36 | | 1100 | | X | | X | | X | X | | X | | | |
| MO_P0074 | Montoyas | Inca Pond | 35.288374 | -106.657375 | 0.62 | | 2500 | | X | | X | | X | X | | X | | | |
| MO_P0075 | Montoyas | Serene Pond | 35.318206 | -106.727441 | 0.5 | | 2000 | | X | | X | | X | X | | X | | | |
| MO_P0076 | Montoyas | Rio Oso Pond | 35.266785 | -106.616322 | 0.5 | | 2000 | | X | | X | | X | X | | X | | | |
| MO_P0077 | Montoyas | Perfecto Lopez Pond | 35.245848 | -106.635074 | 0.75 | | 2400 | | X | | X | | X | X | | X | | | |
| MO_P0078 | Montoyas | Tierra De Corrales Pond | 35.264012 | -106.617028 | 1.21 | | 5000 | | X | | X | | X | X | | X | | | |
| MO_P0079 | Montoyas | Copperton Pond | 35.301774 | -106.702868 | 1.31 | | 4000 | | X | | X | | X | X | | X | | | |
| MO_P0080 | Montoyas | Angel Pond | 35.253493 | -106.627705 | 0.19 | | 600 | | X | | X | | X | X | | X | | | |
| MO_P0081 | Montoyas | Jade Pond | 35.263207 | -106.684255 | 0.1 | | 325 | | X | | X | | X | X | | X | | | |
| NM_P0003 | Montoyas | Roskos Field Pond | 35.223746 | -106.661941 | 0.7 | | 4000 | | X | X | X | X | X | X | | | | | |
| RA_P0001 | Montoyas | Rainbow Pond | 35.253985 | -106.729518 | | | | | X | | X | X | X | X | | X | | | X |
| RA_P0002 | Rainbow | Rainbow Channel (Vancouver to Pecos Loop) | 35.247800 | -106.728182 | 2.26 | 2705 | | | X | | X | X | X | X | | | | | X |
| RA_P0003 | Rainbow | Salitillo Diversion | 35.218479 | -106.717603 | 0.16 | | 500 | | | X | X | X | X | X | | | | | |
| VE_P0010 | Venada | Enchanted Hills Dam | 35.321979 | -106.582643 | 8.55 | | 14000 | | X | X | X | X | X | X | | X | | | X |
| VE_P0012 | Venada | Lower Venada Arroyo NM528 to Rio Grande | 35.313362 | -106.571413 | 11.1 | | 44000 | 5500 | X | | X | X | X | X | | | | | |
| VE_P0013 | Venada | Santiago Channel | 35.311675 | -106.577173 | 2.5 | 2670 | | | X | X | X | X | X | X | | | | | X |
| VE_P0018 | Venada | Mariposa Pond #1 | 35.349415 | -106.692243 | 3.55 | | 17000 | 3870 | X | | X | | X | X | | | | | |
| VE_P0019 | Venada | Mariposa Pond #2 | 35.351503 | -106.689550 | 5.58 | | 25000 | 1120 | X | | X | | X | X | | | | | |
| VE_P0020 | Venada | Mariposa Pond #3 | 35.354348 | -106.685870 | 2.14 | | 10500 | 2930 | X | | X | | X | X | | | | | |
| VE_P0021 | Venada | Mariposa Pond #4 | 35.355679 | -106.684053 | 1.96 | | 9000 | 3683 | X | | X | | X | X | | | | | |
| VE_P0022 | Venada | Mariposa Pond #5 | 35.357274 | -106.682077 | 2.23 | | 10000 | 5742 | X | | X | | X | X | | | | | |
| VE_P0023 | Venada | Mariposa Pond #6 | 35.359242 | -106.679212 | 2.23 | | 10000 | 2888 | X | | X | | X | X | | | | | |
| VE_P0024 | Venada | Encantado Channel North | 35.337223 | -106.585103 | 12.5 | | 8000 | | | X | | X | | X | | | | | X |
| VE_P0025 | Venada | Chayote Pond | 35.349148 | -106.617460 | 4.48 | | 12000 | | X | | X | | X | X | | X | | | |
| VE_P0026 | Venada | Santa Fe Hills Pond | 35.344920 | -106.601035 | 4.85 | | 12000 | | X | | X | | X | X | | X | | | |
| VE_P0027 | Venada | Sprint Pond | 35.333895 | -106.581728 | 9.05 | | 15000 | | X | | X | | X | X | | X | | | |
| VE_P0028 | Venada | Encantado Channel South | 35.329451 | -106.576815 | 5.58 | 4860 | 25000 | | | X | | X | | X | | | | | X |
| VE_P0030 | Venada | Encantado Pipeline North | 35.343257 | -106.598384 | | 4521 | 10000 | | | X | | X | | X | | X | | | |
| WC_P0004 | Willow Creek | Nacelle Pond | 35.315186 | -106.595389 | | 0.5 | 2000 | | X | | X | | X | X | | X | | | |

# Arroyo Classroom

## 2019-2020 final report

submitted by
Erin Blaz, CSWCD
May 2020

## SUMMARY

The Arroyo Classroom program utilizes our natural arroyos as outdoor classrooms and brings local animals into the classroom to motivate 3rd graders to respect the arroyos as important wildlife habitat. Orilla Consulting, LLC developed the program in 2012 and initially implemented the program for 7 classes at Maggie Cordova Elementary in Rio Rancho. In 2013, the program grew to serve 20 classes. On July 1st, 2015, Orilla Consulting, LLC transferred the program to Ciudad Soil and Water Conservation District as part of the larger education and outreach efforts we are involved in throughout Bernalillo and Sandoval Counties. In the 2019-2020 school year, we served 35 classes within Rio Rancho Public Schools, reaching approximately 37 teachers and 736 students.

### Participating Schools

| SCHOOL | Number of classes | Number of Students |
|---|---|---|
| Enchanted Hills Elem. | 6 | 104 |
| Martin Luther King Elem. * | 6 | 145 |
| Sandia Vista Elem. | 4 | 79 |
| Maggie Cordova Elem. * | 7 | 151 |
| Cielo Azul Elem. * | 6 | 132 |
| Puesta del Sol Elem. * | 6 | 125 |
| **TOTALS** | **35** | **736** |

* Title 1 school

**Sponsor**

- Southern Sandoval County Arroyo and Flood Control Authority (SSCAFCA)

**Sponsor provided a total of $17,762.77 in cash.**

**Deliverables:**

*All presentations were completed except for 6 Arroyo Walks due to school closures due to the global pandemic.*

- Watershed Presentations: 35:35
- Arroyo Walk: 29:35
- Bat Presentations: 32:35 (some classes doubled up due to a scheduling issue, all classes completed)
- Owl/Bird Presentations: 35:35



# Program Description

The program consists of a four-part series of lessons, based on grade-level science standards and addressing areas of interest to SSCAFCA, such as bats, burrowing owls, ATV use, pet waste, and arroyo safety. Educators Melissa McLamb and Erin Blaz delivered two of the lessons – an introductory lesson about watersheds, and a walking field trip to nearby arroyo habitat. Justin Stevenson of RD Wildlife Management, LLC delivered a lesson using live microbats. Mikal Deese, certified wildlife rehabilitator of non-profit On A Wing And A Prayer, delivered presentations with a live Burrowing Owl or other birds of prey when requested.

The watershed lesson expounds on the water cycle, already integral in 3rd grade curriculum. This year, we developed a hands on lesson where students were able to build a model of a watershed. This lesson introduces the concept of a watershed to students, demonstrates how surface water becomes polluted through a variety of waste, and discusses the importance of keeping our arroyos clean.

The arroyo walk is a highlight for students and teachers, as the majority of participating classes only receive one other field trip during the school year, and students always come away learning something new and interesting about the uniqueness of arroyo habitat. This lesson is about the unique adaptations of arroyo animals and plants, incorporates a walk out to a nearby arroyo (when available) and extensive discussion about arroyo safety *(see lesson plan in Appendix A.)* Melissa first talked to students about the difference between concrete-lined channels and sandy-bottomed arroyos, and emphasized that it is never safe to go into concrete-lined channels, while sandy-bottomed arroyos can be visited when there are no clouds in the sky. Students searched for evidence of animals living in the arroyo banks, learned about how lizards and other cold-blooded animals are adapted to the desert environment by moving about to regulate their temperature. They also looked for certain adaptations of desert plants to minimize water loss in the desert.

In the lesson about bats, Justin discussed common myths about bats while pointing out how

these myths can pose issues for bat populations as he addressed each one. He taught students about species common in their area, including what habitat they prefer, what they eat, the challenges they face, and what to do if one sees an injured bat. He talked about how important bats are in keeping insect populations under control, shared ways to encourage and protect bats and emphasized that kids should not be frightened of them, but also should never touch a bat if they find one. Students were able to view two different species of live microbats.

This year in addition to the burrowing owl lesson Mikal Deese, certified wildlife rehabilitator of non-profit On A Wing And A Prayer,, was able to offer an alternative lesson using other birds of prey, as an accommodation for students and teachers that have cultural sensitivities to owls. When requested, Mikal brough in three birds for students to observe - an American Kestrel, Peregrine Falcon and a Swainson's Hawk. In this presentation Mikal gives a wonderful talk that covers habitat, behaviors and threats to these species. As a bird rehabilitator she also shares the personal story of each bird. After each bird, Mikal gives students a turn to ask questions and students sit attentively in and engage in a stimulating back and forth session sparked by their curiosity.

When presenting the burrowing owl, Mikal included an fun role-playing activity for students where they had to collect food (dried beans) and bring them back to their chicks. Some kids played adults, others were hungry chicks and in the midst of all the fun and chaos, important lessons are learned. Students get to experience the challenges in competing for food, and learn about human impacts on the food chain - some beans are colored differently and represent pesticides or poisons, which sadly kills off burrowing owls.  Students also get to observe the burrowing owl up close and learn about ways to respect and protect their habitat.

# Evaluation

Teacher feedback for 2019-2020 was positive and encouraging. Teachers overwhelmingly say they choose to participate in Arroyo Classroom to teach about local ecology and conservation issues, incorporate more science in the classroom and to offer experiential learning opportunities. They find the presentations to be uniquely engaging and meaningful for their students. Teacher's find that Arroyo Classroom is complementary to other 3rd grade units of study such as life cycles and animal adaptations and that the chance to have live animals in their classrooms really helps students integrate what they've learned. As one teacher puts it, "There is much more of an 'a ha' moment when students see this in natural forms versus a created classroom environment. Further, when they meet the animals, they like them and there is more of a connection that they can hurt that animal if they do not respect the environment" (Kelly, MLK).

Teacher's continue to ask for extension activities and some kind of pre-presentation activity to help prime students for the content presented. With the addition of 3 classes this year, there was not as much additional time as was hoped to work on providing these resources to teachers. However the creation of online/virtual/at-home alternatives to our in-class presentations (in case of future school closures) will also provide us with resources teachers can use before and after presentations during normal programming.

**Highlights from teacher feedback:**

"My students really got an understanding of conservation and their impact." -Lewis, MLK

"My students really enjoyed the program this year. I thought the changes to the owl/bird presentation made it so much more interactive! The greatest learning outcomes my students had were the connections they made to their surroundings and community. They were able to learn about an ecosystem that they basically lived in. They connected these ideas when learning about animal and plant reproduction and traits." - Eisenberg, MLK

"Exposure to local ecology and have students start thinking about how they can make a difference in our community to promote conservation. Increase curiosity and knowledge of local wildlife." - Cooper, Enchanted Hills

"We really enjoyed the owls and the bats! Students are more excited to learn about a subject when they have an experience to attach/ relate their learning to. We also enjoyed the hands-on activities provided with each of the lessons." -Davis, Puesta del Sol

"I believe this past year was the best year to date. The presenters were engaging and were able to manage student conduct in a knowledgeable way. The activities were also relevant and engaging. The introduction to watersheds allowed students a hands-on activity that related well to the content being taught. The arroyo walk is also a great way to expose the students to the environment directly around them , looking at it through a different lens". - O'Connor, MLK

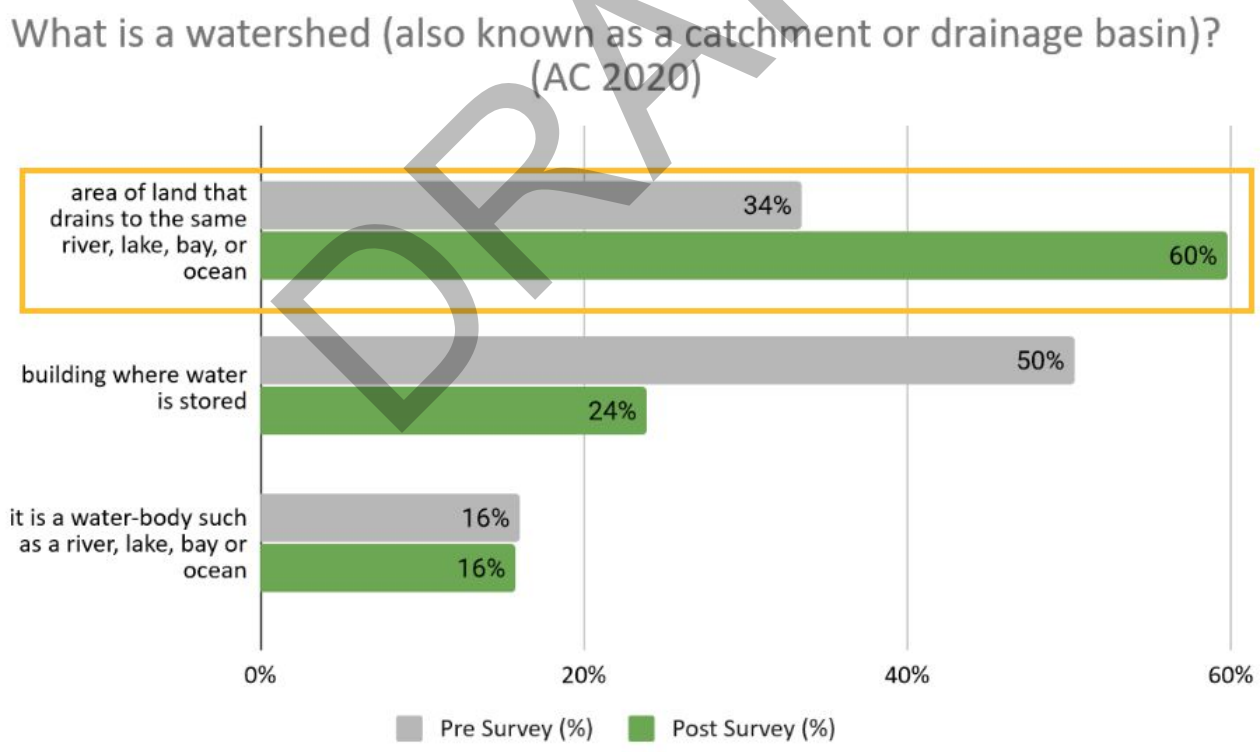
## Survey Summary

This is the second year that we've administered the pre and post surveys for Arroyo Classroom and we ran into a significant challenge in getting post-survey responses because it was distributed to teachers just before COVID-19 shut down the schools. It was recommended to teachers to share it on an online platform, like google classroom, but we only received 232 responses compared to 518 pre-survey responses.

Even with fewer responses this year, in reviewing the metrics there appear to be other challenges with the survey. Across questions a majority of students are answering correctly in the pre-survey. On one hand this is great news to hear that students have an awareness of what arroyos are, arroyo habit and arroyo safety. However, this doesn't tell us much about the program's impact. We will revisit these questions over the summer to try to narrow down the learning outcomes and growth we are looking for. This survey does not have behavior questions either. While we are finding behavior change questions have their own challenges to evaluate, it may be more significant to evaluate behavior change for Arroyo Classroom in order to see how their learning is translated.

## Survey Metrics:

**Item 1**

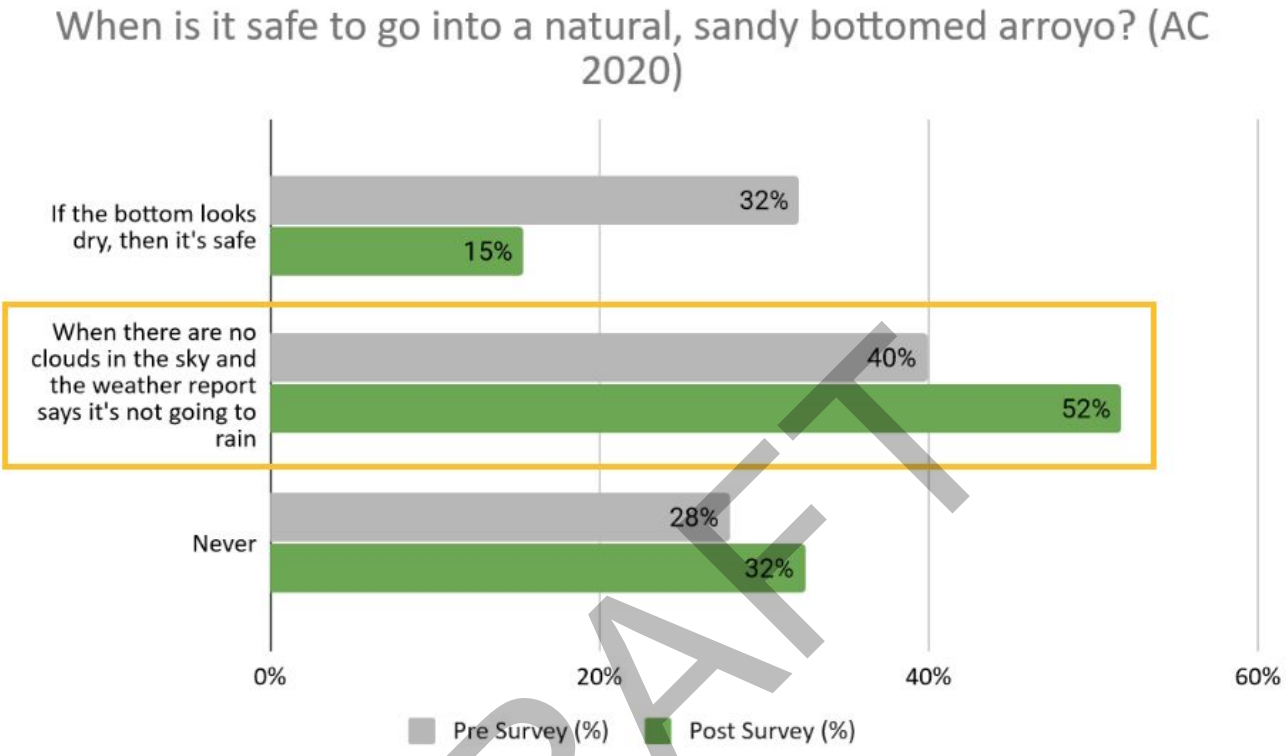





The increase in correct answers for 'what is a watershed' is notable. This could be a result of the improved watershed lesson that was implemented last year, or that teachers are doing a better job of reinforcing the concept. Another interesting finding is that there is an increase in kids claiming it is

never safe to go in an arroyo in the post-survey. This happened last year as well.

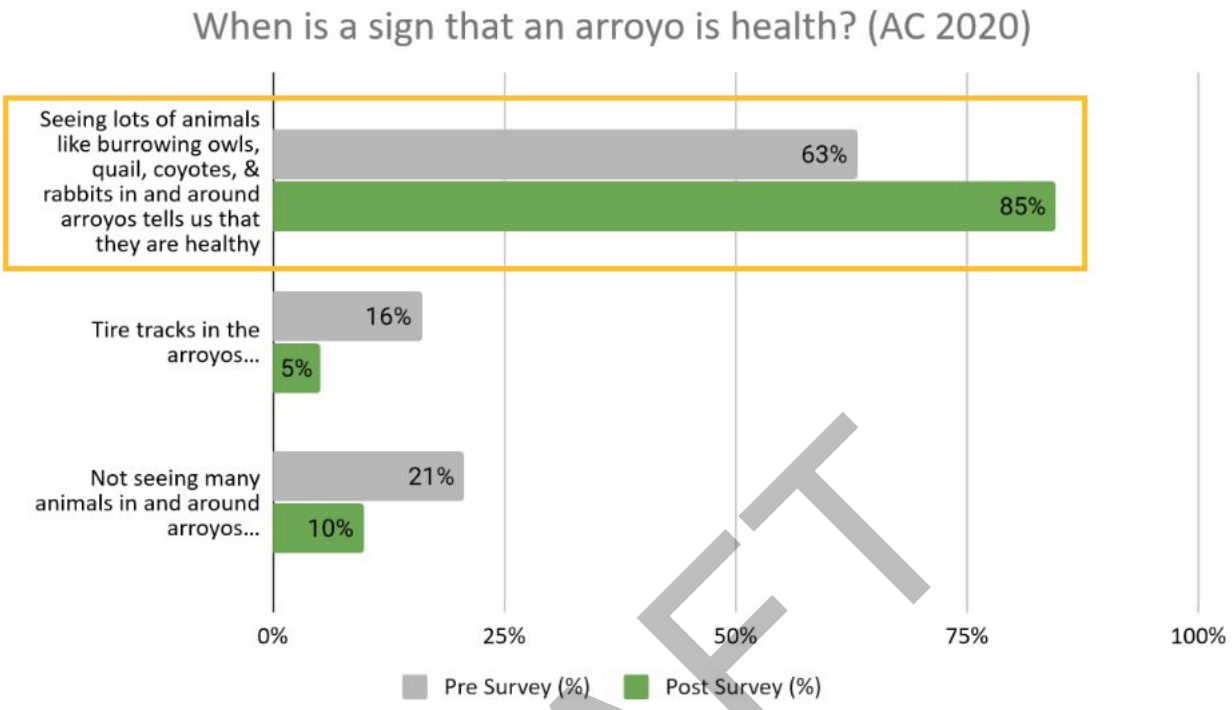
**Item 2**






Another interesting finding is that there is an increase in kids claiming it is never safe to go in an arroyo in the post-survey. This happened last year as well. Extension activities that follow up on the presentation would be helpful in clarifying when it is safe to go in a sandy-bottomed arroyo. The Arroyo Walk can be a stimulating experience and some kids might just miss this information. It may be worth repeating in the watershed presentation as well.

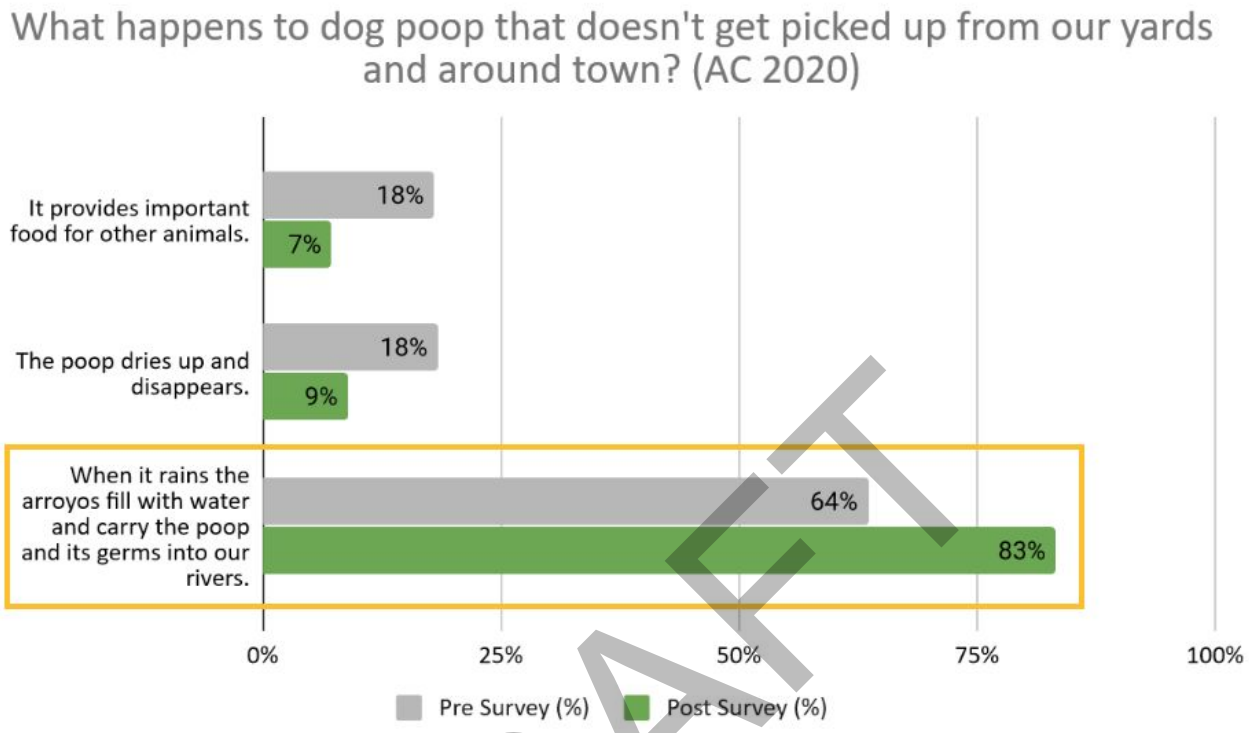
**Item 3**



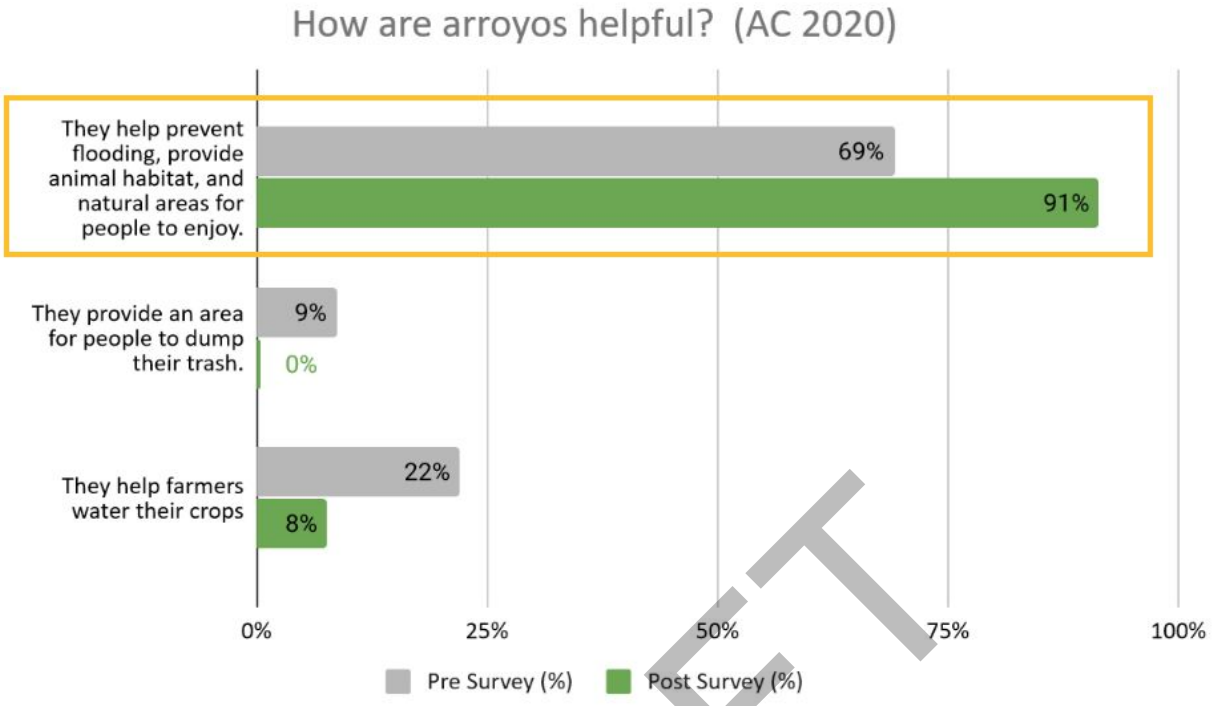



The incorrect answers in the question may be too leading. Kids might not understand the importance of species diversity when they answer this in the pre-survey, but they can assume that tire tracks and lack of animals is not a sign of health. They may have more contextual understanding in the post-survey, but we can not know for sure.

**Item 4**


What happens to dog poop that doesn't get picked up from our yards and around town? (AC 2020)
It provides important food for other animals.
18%
7%
The poop dries up and disappears.
18%
9%
When it rains the arroyos fill with water and carry the poop and its germs into our rivers.
64%
83%
0%
25%
50%
75%
100%
Pre Survey (%)
Post Survey (%)

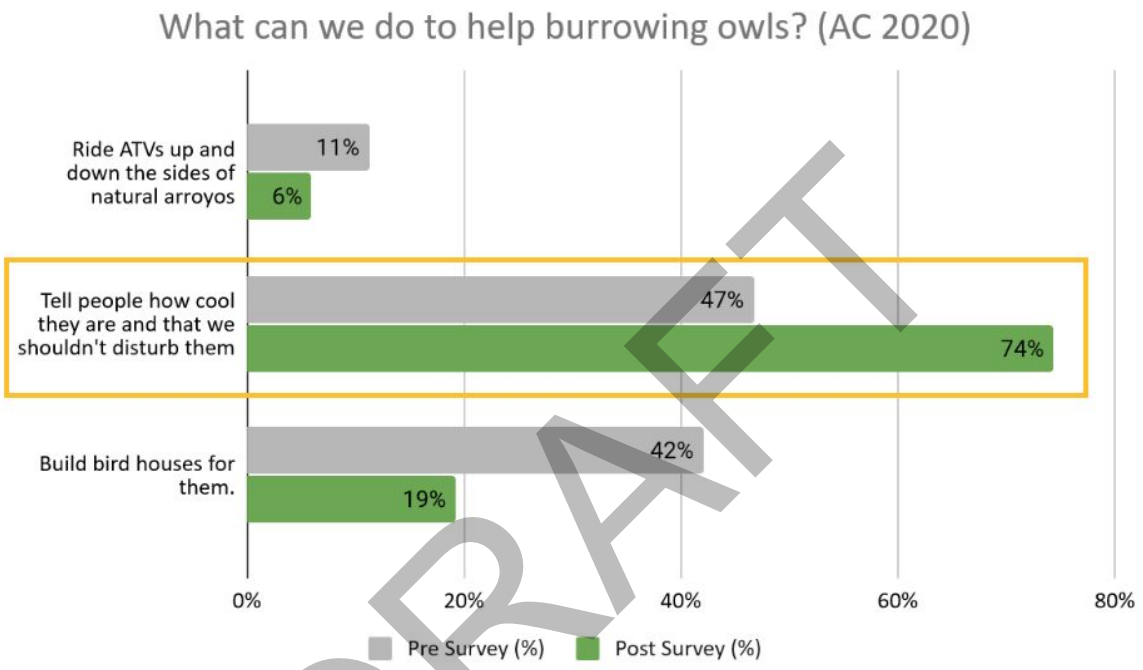
**Item 5**



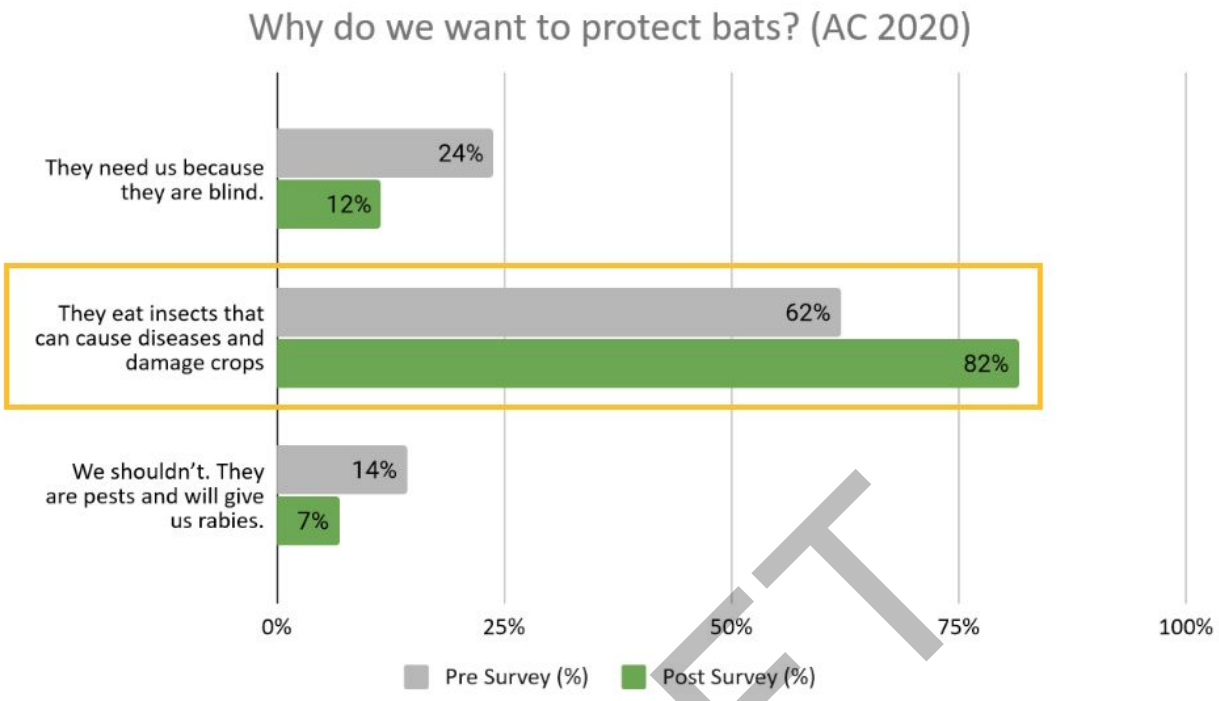

This question was adjusted to make the answers less obvious. The most important finding is that no one answered that arroyo is a place to dump trash in the post-survey!

*The following items 6, 7 and 8 demonstrate similar patterns to those above where the majority of students are answering correctly on the pre-survey , with a positive increase in correct responses on the post.* These results are also extremely similar to the year before and this is not particularly informative. The questions will need to be revised for next year.

**Item 6**



**Item 7**

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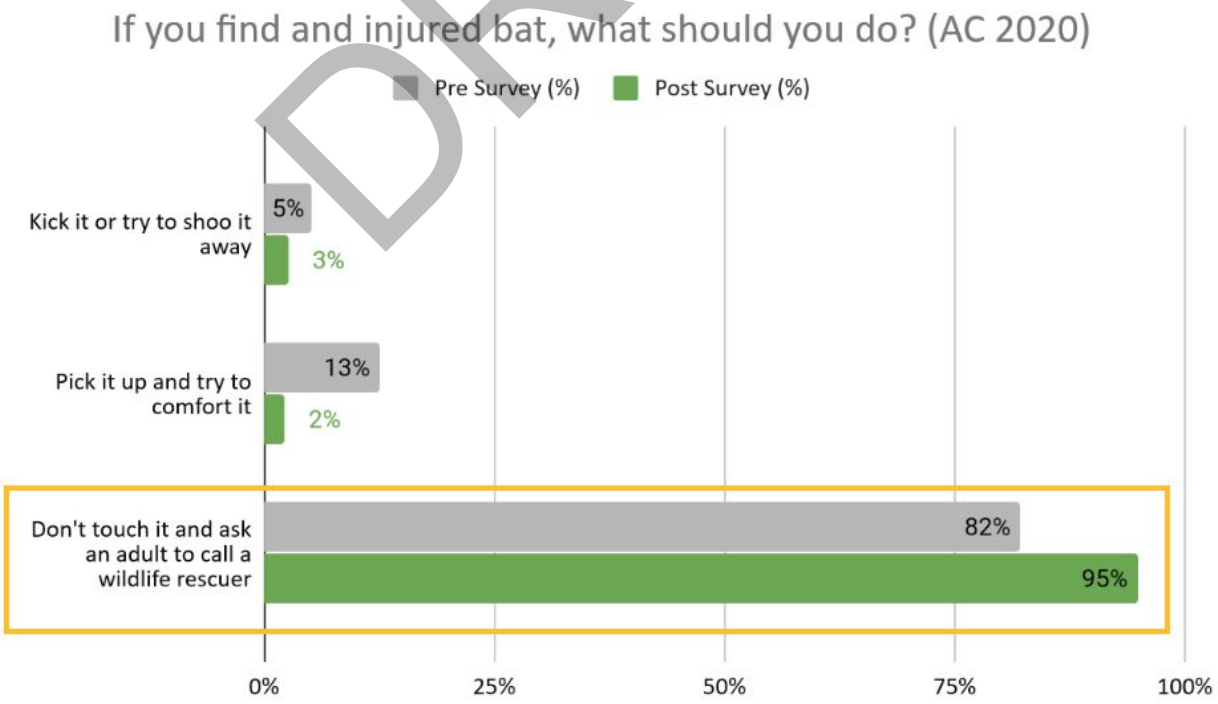


*Appendix A contains lesson plans; Appendix B contains supplemental materials; Appendix C contains photos.*

**Appendix A**
**Lesson Plans**

## *Activity Guide for 3rd Grade – Animal and Plant Adaptations*

**1. What are we trying to teach the students in this activity?**
Arroyos are cool places where animals live, animals and plants are adapted to live in the desert.

**2. How can we tie this activity to our teaching goals:**

| Our Goals | Where we can relate our goals to this activity |
|---|---|
| Animals live in arroyos | Look for evidence of animals. |
| We should visit arroyos carefully | Talk about when it is safe. |
| Picking up dog poop keeps germs out of our river | We'll probably see poop, talk about how it can make animals sick. |

**Supplies:**
- Thermometers
- Clipboards
- Poster of leaf adaptations
- Wax paper
- Paper towels
- Tape

**3. How can we tie this activity to standards?**
- Measure energy (temperature change)
- Posing a question, using numerical data, various methods to display results
- Animals and plants have adaptations that improve chances of survival
- Classifying animals and plants
- Living things cause changes to their environment, some detrimental, some beneficial

**5. How should this activity be organized?**

I. Pre-activity (10 minutes)
- Do you ever visit/play in arroyos? What do you do?
- What are arroyos for? Managing stormwater to keep our town from flooding when we get a heavy rain. **Show first flush video.**
- Talk about arroyo safety – don't go into arroyos when you see clouds in the sky.
- Because our arroyos are natural, with sandy sides and bottom, they are safer.
- In Albuquerque, the arroyos have concrete sides and water travels so fast, it is really dangerous to ever go in arroyos. Some arroyos come from the canyon where it might be raining but you can't see.
- Our arroyos are home to all kinds of animals and plants, so they are a wonderful place to enjoy nature. What kinds of animals do you think might live in the arroyo?
- Walk out to arroyo

II. Lizard activity (15 min)
- 5min Look for evidence of animals. What kind of evidence? Scat, tracks, holes.

- What kind of animals live in holes (besides snakes)?
- What do you think makes it difficult to live out here? Heat, sunburn, not much water, cold at night. Animals and plants have special **adaptations** (special things about their bodies) that make it easier for them to live in this habitat.
- How do they get water? From plants, from condensation under rocks.
- How could they avoid heat? Stay in burrows or shade during the day, active at night.
- Some animals love the heat, though! Lizards are cold-blooded, which doesn't mean they are actually cold. It means their body temperature is determined by the environment. They need to absorb heat from their surroundings to function.
- Each student take a thermometer. This is a lizard, and it needs to maintain its body temperature at a certain level: fence lizard 35C (95F), whiptail 38.6C (101F). How can it keep from getting too hot? How can it keep from getting too cold? Lizards regulate their body temperature through behavior.
- Plants do kind of the same thing – hold one palm out flat, one sideways. Which feels hotter? Prickly pear cactus pads grow sideways instead of flat to keep themselves cool!

IV. Plant activity (15 min)

- What do plants need in order to survive? Water, sunlight, air, soil
- What makes it difficult for plants in the desert? It's so hot and there's so little rain.
- How do plants get water? **Show evapotranspiration diagram.** It's kind of like when we're hot, we sweat. But if we lose too much water from sweating we get dehydrated.
- How do they keep cool? Remember prickly pear? **Show pictures of hedgehog and prickly pear cacti.** Desert plants can **s**hade themselves! Hedgehog cactus has lots of spines that shade the surface and also blocks the wind.
- The leaves of many desert plants are **adapted** so that they don't lose too much water.
- Show leaf adaptations poster (fuzzy, small, curled, waxy, green stems but no leaves)

**If weather is ok:**

- Out in arroyo, we'll do an investigation.
- How many of the plants we see will have these adaptations? Hypothesize.
- To be fair, we can't just pick the plants we like. Standing in one spot, collect the first 6 *different* leaves you see.
- Draw each one, and describe what adaptation it has.
- How many of your 6 leaves have one of the adaptations listed?
- Why don't all have it? Some plants avoid the heat by just growing and producing seed really fast before the weather gets hot, and then they just die off and leave their seeds to grow next year!
- Search for seeds.

**If windy, inside activity:**

- Let's investigate one way they keep water. **Dab water on board, cover one spot with paper towel, one spot with wax paper.** Which do you think will evaporate faster?
- **Show prickly pear picture.** Make model of prickly pear pad: paper towels with wax paper taped around the outside. **Show cut prickly pear pad.**
- Maybe do an experiment: soak wax-covered and non wax-covered leaves in water and time how long they take to dry.

V. Conclusion (10 min)

- Arroyos are for flood control, and we shouldn't play in them when clouds are in the sky.
- But they are cool places where animals and plants live, and we can visit when it's clear weather.
- Animals and plants are adapted to live in the desert climate.
- What we do in arroyos affects the plants, and animals' habitats. Should we ride ATVs up the sides? That's something humans do to change our environment for the worse.
- Picking up dog poop is important because it can make animals sick. Where does the water go when it flows down the arroyo? The Rio Grande! Keeping dog poop out of the river is one way humans can change our environment for the better.
- Walk back to classroom

# Leaf Adaptations

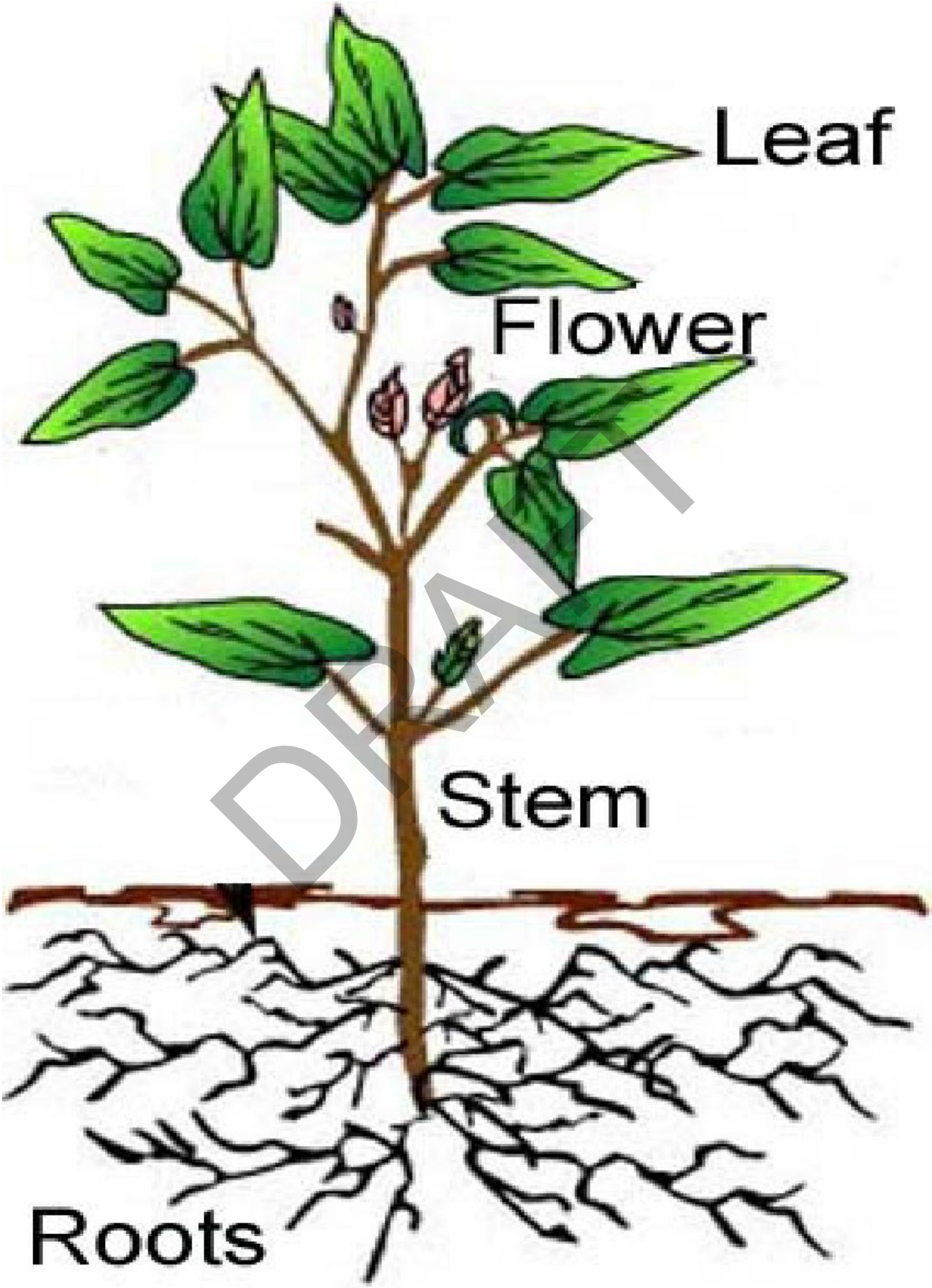
1. Fuzzy leaves or lots of spines

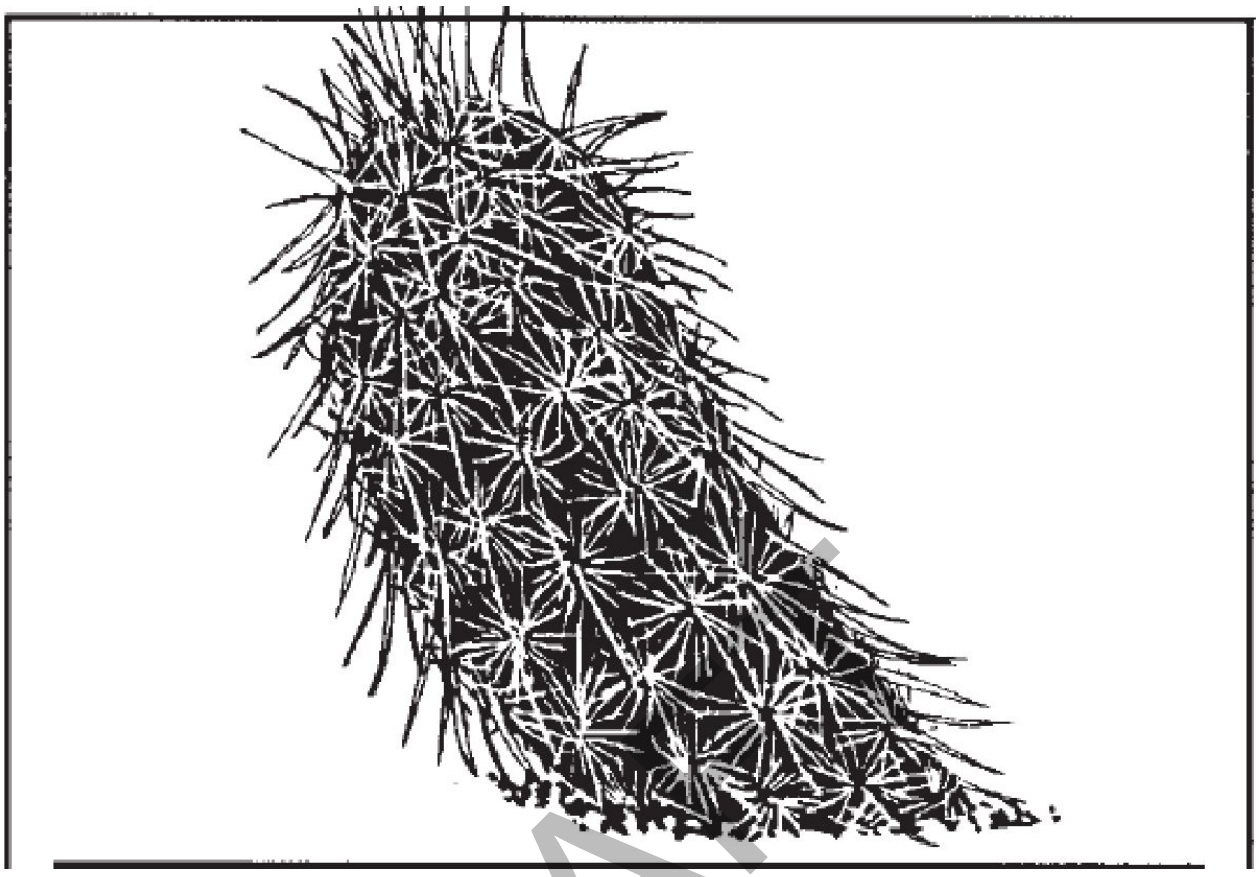
2. Small leaves

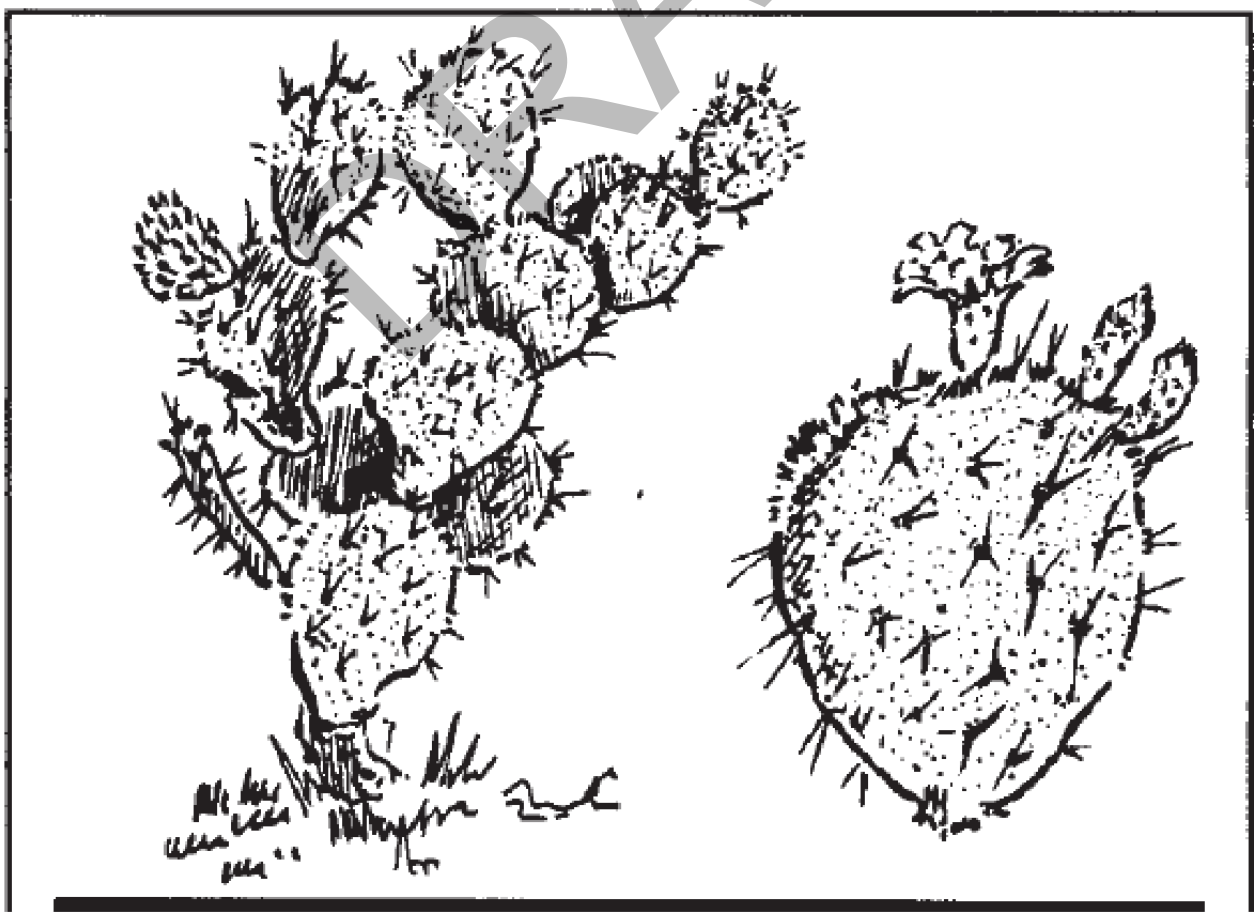
3. Curled leaves

4. Waxy leaves

5. Green stems but no leaves!







# ***Build a Watershed Activity Guide for Arroyo Classroom***

1. What are we trying to teach the students in this activity?
**What is a watershed? How does the water cycle work? What are different forms of pollution and how does it impact our river? Arroyos lead to the river and carries different types of pollution with it.**

**NM State Science Standards:**

| **3rd Grade** |
|---|
| Water cycles through the atmosphere, plants, soil, and bodies of water in various forms. |
| Describe pollution and identify different types (can be naturally occurring or human made materials). Pollutants can get into our water and harm living things. |
| Some animals can survive better in certain environments, some will not survive at all. |
| Describe how roots take up water and soil nutrients, and leaves make food from sunlight. |

2. How can we tie this activity to our teaching goals:

| **Our Goals** | **Where we can relate our goals to this activity** |
|---|---|
| How does the water cycle work? | Describe the processes of the water cycle: evaporation, condensation, precipitation, collection, run-off and infiltration. |
| What is a watershed? | A watershed is all the land that drains into a river or other body of water, from mountain forests to riparian zone. |
| What makes water dirty? | Pollution comes from all over the watershed, and erosion is one form of pollution. |
| Why are arroyos important? | Arroyos provide important drainage in a storm event and provide unique and critical habitat for wildlife and plants. |
| How does vegetation help our river? | Forests, wetlands and healthy arroyos help keep the river clean and prevent flash floods. Plants in these areas slow the runoff of water into the river, reducing erosion and flooding. They can also remove nasty chemicals from the water by taking them up through their roots. |

3. What is effective in this activity? Being in small groups, students enjoy creating the model and discussing what they are observing.

4. What makes this activity difficult to teach? Students get excited and want to play with materials while you are talking.

**Activity Materials**

- Blank paper, markers, aluminum pans to capture water
- markers (ex: black for oil, brown for dog poop, red for trash)

- a watershed map (ex: SSCAFCA watershed map, It's All Connected in a Watershed poster)
- NM relief map

**<u>Preparation</u>**

- Post watershed map
- Draw sketch of the water cycle
- Have materials laid out and desks arranged (papers, trays, sets of markers)
- Optional: write out key for marker colors (keep hidden until time to show students)

**I. Intro – 5 minutes**

1. Introduce yourself and the Arroyo Classroom program: Respect and Know your Arroyos
2. Cover guidelines/expectations in order to be able to have a good time and learn together
3. Introduce what we will be learning: What is a watershed? Where does it go when it rains? We are going to find out how water moves across land, and through our arroyos, when it rains or snows. And learn about how it carries things with it as it flows.

**II. Warm Up – 10-15 minutes**

1. How many of you used water before you came to school today? How did you use it?
2. How else do people use water on a daily basis?
3. Where do you think all this water comes from? (Discuss the aquifer and it's connection to precipitation). Point out groundwater shown on the "It's All Connected in a Watershed" poster.
4. Pull out the NM relief map. Discuss the purpose of a map. Walk through so each student can view. Introduce the concept of a "key". Have them help you find ABQ on the map and the Rio Grande. Point out the area of Rio Rancho. Explore the map together.

**Ask: (Really engage with students and listen to their ideas)**

- Has anyone heard of the term "watershed" before? You can highlight that it is a compound word. Have students share what they think of when they hear this word usually, "a shed full of water." It's kind of like that! Except the shed (or container) is an area of land. *Everyone lives, plays and works on land that draws to a body of water, like a river, lake, bay or ocean.*
- Point out the Rio Grande Watershed through the middle of the NM relief map.
- Where are there mountains and hills? Where do you see rivers and lakes?
- What would happen if we sprayed water on the mountain peaks, what will happen to it? *It will flow downhill.*
- Where does the water come from in nature? *Rain or snow*

**III. Activity – 25 minutes**

**Where does the water go?** Let's find out by making our own model/map, similar to the relief map.
**Part A: 10 min**
While students are still sitting, demonstrate activity → crumpling paper to drawing on the ridges. Identify the ridges. Ridge as high point of range of hills or mountains. Point out that it is where the

paper has a peak pointing up not down. Maybe identify the difference between a peak and a valley using the paper.

1. With your imagination, imagine that this piece of paper is a piece of land.
2. Crumple up the piece of paper and then smooth it back out most of the way. Leave it a bit crumpled, showing small ridges (high points) and valleys (low points).
3. Find the ridgelines (tops of the fold lines). Use the blue marker to color along the ridgelines on your "land".

Model this for students briefly. Be sure everyone understands the activity. Ask students to crumple their paper and draw their ridgelines. Once they are complete - Hands on their hand so we know they are ready for the next step.

Pair students (groups of 2 or 3), with teachers help. Assign roles 1-2, or 1-3.

Give Roles***: We're all observers, everyone will have a turn.

Have groups gather around their tray. Drawers can begin drawing their ridgelines. Announce that students have 30 more seconds when it seems that each group has enough ridgelines.

Next, demonstrate a "rain event". Model for students the distance we want them to aim from as they spray (i.e. the length of your elbow to hand, vertically placed on the tray). And 4 sprays. (idea: Students can be drill sergeants about the three sprays, acknowledge that sometimes the spray bottles act funny but that we are trusting our classmates to count for themselves to do only four full sprays...).

**Ask:**

- What do you think will happen to your land when it "rains"?
- What will happen to the blue ridge lines? / Where will the "rainwater" travel?

1. Altogether, sprayers squirt your model a few times to create a "rainstorm" over your land.
2. Observe what happens.
3. As your rainfall accumulates, watch the pathways where the excess "rainfall" travels.

With teachers, walk around to ask each pair to explain what the water is doing and show you rivers and streams in their model.

Have teachers help pick up all the spray bottles, and ask everyone to place their hands on their head and have a small group discussion about their observations.

**Part B: 15 min**

Have pairs switch roles, “disposers” can throw out previous model. Tell students they will keep the same number assigned earlier and tell them what role they will be playing. You could write these on a whiteboard.

**What’s In the Water?**
*Experiment with how “pollutants” might travel through their watersheds.*

With a new piece of “land”, imagine this represents the City of Rio Rancho or the Rio Grande Watershed. Show one of the Watershed posters and point out all the human activity that happens in a watershed (driving cars, making things (manufacturing), farming, walking our dogs, etc.)

**Ask:**

- What might be on this land that we wouldn’t want in our water?
- What is pollution?
    - Have you ever seen it? What does it look like?

As students share, note the types of pollution on a poster or white board and create a key for groups to use. (Roads/Cars - black, Trash - Green, Dog poop-brown (and/or orange if you have more groups than markers)) Depending on the group, you could also identify Factories - Red

Before crumpling, have drawers (with their support drawers) mark their papers with the brown, red and black marker to represent farms, factories, houses, streets, dog poop and trash.
Announce that students have 30 more seconds when it seems that each group has drawn enough. Then ask all students to put their hands on their head.

Then have crumplers -crumple paper and then partially smooth it out.

Altogether, have sprayers spray the piece of paper.

**Ask:**

- What happened to the pollution when it rained?
- Describe what happened at the highest and lowest point in your watershed.
- How quickly did it spread? Are there any places on the land where it didn’t go?

**WRAP UP: -5-10min**
**What do you think this means for our watershed - the Middle Rio Grande?**
*The water we drink comes from our watershed. Animals and plants also depend on this water. That’s why it’s important that we try not to pollute either the water or the land. Anything that pollutes the land will eventually wind up in the water.*

**What might be ways we could reduce pollution in our watershed?**

*By picking up trash and picking up dog poop if we have dogs. (*I like to emphasize to this age group that **being responsible is powerful** and they can make a difference by caring and picking up their own trash. I also tell them that last year a whole grade level of 3rd graders at Cielo Azul Elementary helped pick up 1.8 tons of trash!)

Thank the class for their attention and participation. Tell them we look forward to seeing them again and expect that they show the wildlife biologists the same respect they have shown us.

*****Groups of 3: Each person gets to spray 3x. Model this for them.**
***For groups of 3, you'll need two blue markers for Part A.***

**May be helpful to tell students each turn has a Lead Role and a Supporting role (Supporting role noted in parentheses).**

Part A Roles:
1 - Drawers (+ spray)
2 - Crumplers (+ drawing / spray)
3 - 1st Spray (+ disposers) -- Spray 3, 2, 1

Part B Roles:
1 - 1st Spray (+ disposers)
2 - Drawers (+ spray) --Spray 2, 1, 3
3 - Crumpler (+ draw)

**Groups of 2:**

Part A Roles:
1 - Crumpler / Drawer
2 - Sprayer / Disposer

Part B Roles:
1 - Sprayer / Disposer
2 - Crumpler / Drawer

**Appendix B**
**Supplemental Materials**

# -SSCAFCA Activity Book and Educational Videos:

KNOW YOUR ARROYOS
ENJOY • RESPECT • PROTECT

# -SSCAFCA handouts:

## Did you know?

SSCAFCA protects our community from flooding and erosion caused by big rain storms, and works to keep stormwater clean. Stormwater flows down arroyos into the Rio Grande.

Bugs like to live in stagnant water that collects in ponds and low places in the arroyos. Insects like mosquitoes can carry diseases that make us sick.

Almost all U.S. bats feed exclusively on bugs, and 1 bat can eat between 600 and 1,000 mosquitoes and other insect pests in just one hour. One bat can eat its own weight in insects in a single night!

SSCAFCA provides bat houses to encourage bats to make their homes near our arroyos, and especially near detention ponds where stormwater runoff is captured and allowed to slowly drain.

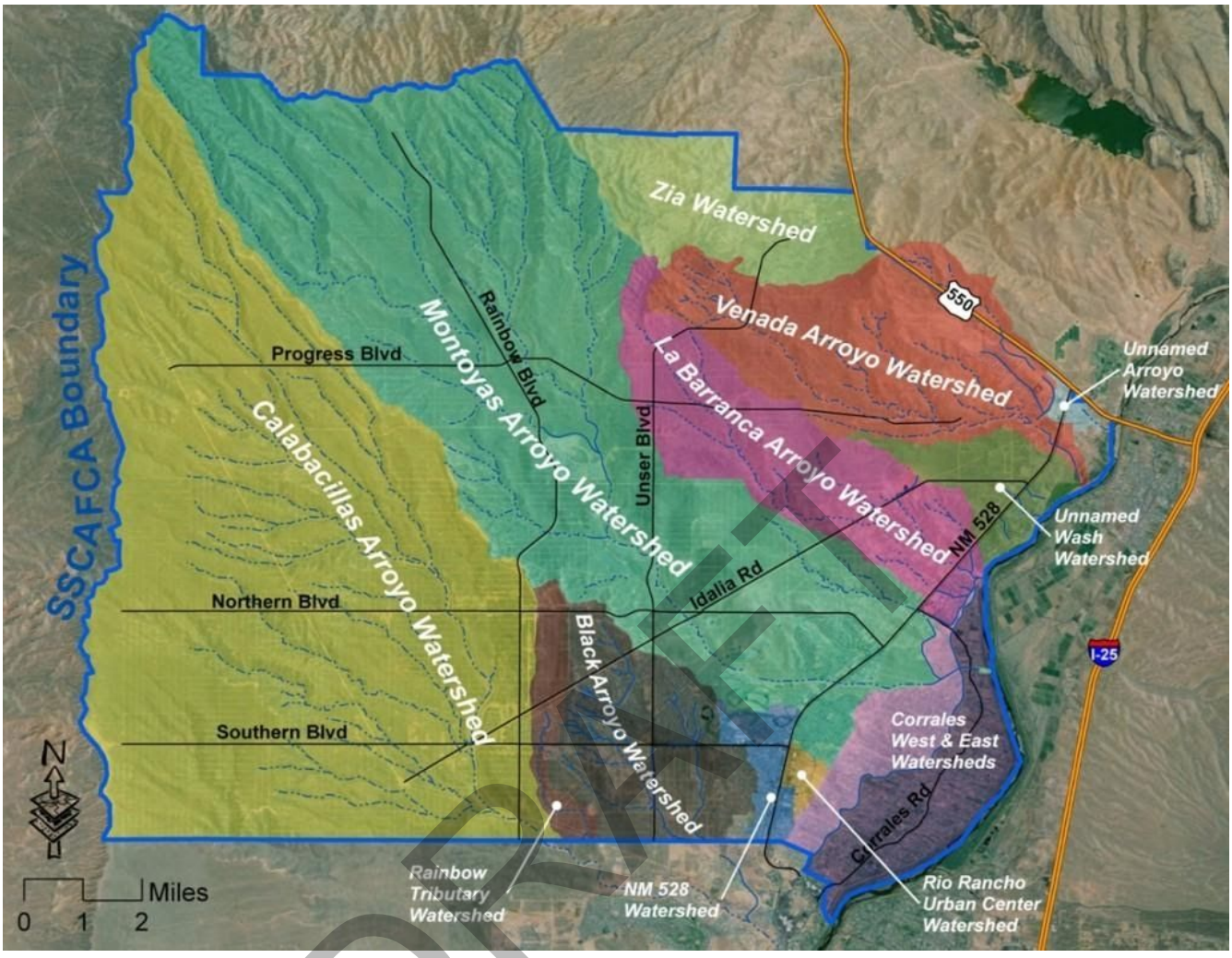
The more we help bats, the more pests they eat, so we don't have to spray pesticide that could wash down to the Rio Grande and pollute it.

Brought to you by:

SSCAFCA

SOUTHERN SANDOVAL COUNTY ARROYO FLOOD CONTROL AUTHORITY

# SSCAFCA watershed map:



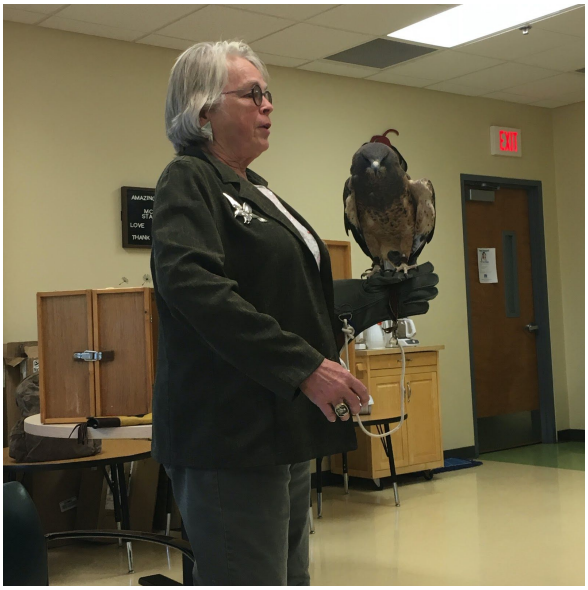
**Appendix C**
**Program Photos**

LEFT - Melissa McLamb discussing desert animal and plant adaptations by Maggie Cordova Arroyo.

BELOW - Students observing and discussing the watershed model.

ABOVE - Students having fun during the arroyo walk on school property. Students gather in between activities to discuss findings such as looking for evidence of wildlife (scat, tracks, burrows, etc.).

RIGHT- Mikal Deese with a Swainson's hawk at Maggie Cordova Elementary.



# Making Meaningful Connections by Integrating Water Resources Topics with Language Arts & Science

## *2020 Report*



Presented by
Ciudad Soil & Water Conservation District

**May 2020**

# CONTENTS

# SUMMARY

This year, funding enabled 38 NM classes (932 students and 38 teachers) to participate in RiverXchange® and learn about critical water resource issues in their watershed. The majority of participating classes were from Title I schools. Every NM class was connected to out-of-state partner classes on the blogging platform for a total of over 1,254 participants. All program costs and coordination are provided free of charge to NM teachers. Training, technical support, and curriculum materials are provided free of charge to partner teachers. The program required $56,157.11in cash and generated total match valued at **$82,115.32** in the form of in-kind contributions including workshop space, classroom resources, presenters' time in the classroom, field trip docents, donated trees, as well as teachers' and students' time.

Even with the impacts of the COVID-19 pandemic and the transition to a new education coordinator mid-year, RiverXchange was able to run smoothly with only a few classes missing a presentation or a field trip due to school closures mid March. The end of the year teacher feedback responses confirm that this year's program was strong as any, as many spoke to their students increased ability to understand local water resources and the impacts of society on those resources, as well as how they can take part in protecting those resources, upon completion of the programs. The following sections discuss how coordination efforts were spent keeping RiverXchange a high quality, relevant program and responding to on-going needs and challenges.



## Presentations

Program presentations were completed as follows:

Agriculture: 29/38
Stormwater: 38/38
Wastewater: 38/38
Drinking Water: 36/36
Planting Field Trips: 32/38

## Program Strengths

Teachers continue to report that the presentations are consistently high-quality, hands-on experiences that engage students; and that the field trip is a highlight of the year for all involved. The presentations explore different aspects of water usage in our community with professionals and experts in the field and continually reinforce to students how they can protect their watershed and the Rio Grande. The pole planting field trip allows students the opportunity to give back to the environment they have learned so much about and their enthusiasm for service learning is palpable on the trip! Furthermore, RiverXchange supports the active participation of teachers in the program by providing professional development opportunities, training to teachers on program implementation, extension activities, and access to a blogging platform for students to connect. RiverXchange incorporates STEM, place-based learning, hands-on activities; and puts conservation actions into the hands of local students and teachers while partnering with stakeholders in the community.

The following sections discuss highlights from RiverXchange this year:

## I. Teacher Workshop

The teacher workshops this year were held at Valle Del Oro and Bachechi Open Space. The workshop schedule included an introduction to the site as an educational resource, an overview of RiverXchange presentations and curriculum, a break-out session, blog training, presentation scheduling and lunch. During the RiverXchange overview, we encouraged teachers to introduce RiverXchange to their class using the River Geography activities. We emphasized that starting students off with an overview of our local watershed, including the Rio Grande is a great way to kick-off the program and bring context to the future presentations. We also suggested that introducing their watershed on the blog as their first class post would be a great way to synthesize this introduction.

This year we also choose to give teachers a focused break-out session with their 5th grade team to consider each presentation and plan how to integrate their own lessons or RiverXchange presentation extension activities to deepen their students' learning experience. The goal was to highlight teacher expertise and give teachers more time to share how they make RiverXchange work in their classrooms with each other. Teachers worked in groups to discuss an assigned presentation and what activities they recommend or wanted to try out. Then they presented to the whole group so that each presentation was covered. Teachers seemed to enjoy getting ideas from each other and the chance to share their practice with everyone. It also gave each 5th grade team a chance to talk about how they were going to integrate RiverXchange into their year.

The teacher workshop also included in-depth training on Kidblog. Each teacher was able to connect to their individual blog, navigate their page, and find important information that would help them be successful. Overall, the time at the teacher workshop felt productive, engaging, reciprocal and fun.



## II. Teacher Feedback

Every year teachers are asked to complete an evaluation survey to tell us why they choose RiverXchange, what works well and how we could improve. This year teachers continued to have positive feedback and shared that the presentations are exceptional and the field trip is “second to none!” Of the reasons teachers state that they participate in RiverXchange, teaching about water resources and incorporating more science into their classrooms are the top choices. Teachers also are finding more and more that RiverXchange helps their students achieve NM STEM READY! standards through hands-on experience, inquiry-based learning, solving real world problems, and engaging in the community. Some teachers still report that they struggle finding computer time and feel unsuccessful on the blog. We also had great feedback from our visually-impaired teachers about the field trip, but that it could be helpful to adapt the presentations for special education students or reach out to the teachers beforehand so they can support those students better.

Here are a few quotes about student’s greatest learning outcomes from participating in RiverXchange:

“A heightened sense of their surrounding community and the overall impact water has on our society.” - Peter Hornbecker, Colinas Del Norte

“Teamwork...the students loved working in groups during the presentations and the pole planting trip. Many of them were still talking about it before school was cancelled”. - Stanee Kitts, MLK

"Students became more aware of their environment close to their home and the impact their actions can have on the river." -Debbie Beer, Duranes

"Their knowledge about the watershed and how to care for it. The content sticks with them so well because of all the experiential learning." -Ashley Anthony, Monte Vista

"My students were able to move toward understanding water as something to think about, not just a given, unappreciated, unlimited resource." -Rona Gomez, Georgia O'Keeffe

Finally, this quotes summarizes the opportunities teachers get from participating in RiverXchange:

"RiverXchange has helped me step outside my comfort zone to explore, demonstrate, and teach areas that are new to me. It was definitely a benefit as shared by students!" -Randi Sevigny, Seven Bar

### III. Supporting Next Generation Science Standards

The Next Generation Science Standards have been adopted by the New Mexico Department of Education and are in the second year of implementation. The framework of NGSS moves the focus from teaching science facts to the process of *doing* science and requires both curriculum developers and teachers to re-think science education instruction. RiverXchange supports many of the "3 Dimensions" of NGSS framework by delivering inquiry-based curriculum, hands-on learning opportunities and locally focused water resource topics. The next steps are to fully align RiverXchange to the NGSS, and while this is a lengthy process that requires practice before understanding, it will be key in both promoting RiverXchange as a 21st century science education program and encouraging the next generation of scientific thinking and problem solving.



## Program Challenges and Opportunities

In an effort to remain relevant to students, stay updated on current science and technology, and keep up with teacher needs, RiverXchange is constantly evolving. While at its core the deliverables remain constant, each iteration of the program aims to be a more improved, polished version of itself. As the recently hired Education Coordinator, I believe it is valuable to share some of the insights that I have gained as a consultant to the program, and document them here as a way to convey some of the challenges and opportunities that Melissa McLamb and I were responding to during our time working together. Especially as the program is now faced with new challenges and opportunities in responding to the COVID-19 pandemic, this section serves to hold that institutional knowledge and will be important to remember once things settle down.

### I. Ensuring High Quality Presentations and In-kind Partnerships

*Challenge: Maintaining our agreements for in-kind partner presentations when we lose a partner.*

RiverXchange is dependent on our in-kind partners to deliver the four in-class presentations and relies both on the availability of these partners and their expertly crafted lessons to meet our objectives. The only

drawback of such a strong partnership is that when an agency is no longer able to provide this service, it takes time to find another partner who can meet such a specific niche. This has been the experience with the agriculture presentation that was previously provided by Bernalillo County Extension to APS participants. As a response to this gap in 2018-2019, RiverXchange staff developed a presentation that explored the regional history of agriculture and irrigation techniques, which highlighted acequia culture and the effects of human settlement on the Rio Grande. During that year we entered discussions with CESOSS (Center for Social Sustainable Systems), as they were working on creating an Acequia Education Office in the South Valley and agreed they would be a good candidate for providing these presentations. However, the timeline for the development of the Acequia Office and their limited funds have proved to be barriers for now.

*Response: Maintaining a network of in-kind partners who can provide RiverXchange presentations.*

This year, we were able to call on the help of BernCo Master Naturalists and found that they are a well-suited group to recruit presenters from. This summer we intend to recruit Master Naturalists earlier to ensure availability and cover all presentations, as working with volunteers requires flexibility and grace. Furthermore, it should be noted here that all future RiverXchange staff should have an up to date understanding of each presentation and the capacity for networking to ensure partnering opportunities are easily accessible.

## II. Kidblog: The current blogging platform

The continued agreement with an educational contractor this year allowed for an increase in capacity for blogging support. Time was spent working with the Kidblog support specialist, Laura Kniffin, to understand the platform and how it can work with the specific needs of our program. The following changes this year were the result of those conversations.

- **Rostering**: Rostering is an efficient way to create new blogs and users using .CSV files at once, rather than doing each blog and user one by one.
- **Individual class blogs**: We returned to each class having their own blog rather than grouping two or three on one with the goal to reduce confusion on how the blog is used and encourage classes to build a more unique identity on their blog. It also allows returning teachers to keep the same blog year after year, and further reduces time spent getting new blogs set up for both teachers and coordinators.

## III. Connecting NM classes with partner classes via Kidblog.

In working closely with partner classes the previous year, our goal this year was to increase posting by partner classes and strengthen connection with NM classes. The following were challenges identified from the previous year and our responses in 2020-2021.

*Challenge: Creating strong partnerships with NM and out-of-state partners on the blog takes significant coordination.*

- **Out-of-state partners have varied schedules and the timing of their water-related lessons do not always line up well with our program.** This creates a challenge on both sides. Partner classes

are recruited on the premise that we will provide them with an active class on the blog that will be discussing water related topics. For a one-on-one partnership to be successful, the NM class has to be active and do so within a time frame that is convenient for the partner class and vice versa.

- **Active participation on the blog varies by teacher by year.** A teacher might be super active on the blog one year and completely absent the next. Circumstances change year by year, it is hard to rely on one teacher behaving similar to the year before.
- **Organizing who is doing their water-focused unit at what point in the school year takes time that is not well spent if neither partner actively participates on the blog.**

*Response: Use coordination time available to make blog user-friendly and increase teachers fluency on the blog to increase active participation for NM and out-of-state classes.*

- **Teacher workshop included training on each teacher's actual blog.** Teacher's were able to work side by side on their own blog (rather than just see examples), ask direct questions and troubleshoot. This requires all blogs to be set up before the teacher workshop, but allows for better understanding.
- **Out-of-state partners attention increased.** Each partner was interviewed to better understand their goals and their timeline. They received one-on-one, virtual training on the blog, technical assistance and general support for implementing the blog in the classroom throughout the year.
- **NM and partner classes all connected on the blog.** Kidblog has a "Connection" function that links classes to other classes visibly on each blog page - where they can easily go to another classes blog, see posts and comment. This year in addition to having assigned partners, all classes were linked to all other RiverXchange classes under the "connection" feature on Kidblog. While the goal was to create more ease in finding active classes to comment on- the number of connections seemed to have over-stressed the system and slowed down loading times on Kidblog for our users. Even with improved accessibility to partner classes, there were only a few classes that corresponded with other out of state classes this year by sharing comments back and forth.
- **Distribution of monthly Mailchimp emails with blog highlights, tips and resources.** To further increase creative blog posting, instigate class connections, and improve Kidblog fluency, a monthly newsletter went out that provided a summary of blog activity, shout-outs for recent posts and updates on out-of-state partner posts with links directly to those blogs to see their work.



*Opportunity: Connect with regional upper elementary watershed programs that might provide sustained partnerships between teachers and programs over the years.*

In 2020, Ciudad SWCD acquired the licensed trademark of RiverXchange® from Amy White, which grants CSCWD the sole oversight of the program and the ability to evolve the way we meet the "exchange" mission so integral to the program. Considering the challenges with the blogging platform, teacher engagement on the blog and connecting NM students with out-of-state students, we have been in search of other opportunities. One avenue is to strengthen a partnership with an out-of-state program that is similar to RiverXchange and develop a long term relationship. Another is to explore in-state programs that are similar and devise a strategy that would allow our students to connect possibly through the blog, via snail mail or even create podcasts to share. Santa Fe Watershed Association manages a 5th grade program called My Water My Watershed and could be a great candidate to try for a stronger exchange between students - one that would connect students across watersheds along the Rio Grande.

# PROGRAM DESCRIPTION

## Mission

The mission of RiverXchange is to deepen students' and teachers' understanding and appreciation for their local river ecosystem, motivate participants to protect local water resources by conserving water and keeping their source water clean, and to provide a high quality, high impact outreach opportunity for funders and in-kind contributors.

## The Big Water Questions

The optional curriculum frames program outcomes as "guiding questions," known as *Big Water Questions*. A long term goal of RiverXchange is that students understand these questions and can formulate logical, fact-based answers by the time they finish elementary school. We believe that students who can synthesize water facts to understand larger water issues will have the proper critical thinking skills and foundation for further discussion in middle and high school so that they will become informed citizens and voters on water issues.

*Understanding a Watershed*

- Is every place in the world part of a watershed?
- Where does your community's stormwater go?
- How can surface water become polluted?
- How does the water cycle relate to weather?
- How are groundwater and surface water connected?
- How can groundwater become polluted?
- What actions can all of us take to keep water clean?

*Water in Our Society*

- In what ways does our society use water?
- Where does your community's drinking water come from?
- Does everyone have the right to use as much water as they want?
- Where does your community's wastewater go?
- What actions can all of us take to conserve water?

*River Ecosystem*

- How does water affect living things in an ecosystem?
- What role do forests play in a watershed?
- What role do wetlands play in a watershed?
- What are some of the ways scientists can determine the health of a river, lake, bay or ocean?
- What actions can all of us take to improve the health of our ecosystem?

## Background

As producers of children's water festivals and other grade K12 water resources outreach in NM since 2007, the RiverXchange program creators observed early on that NM elementary teachers rarely incorporated water concepts in the classroom beyond what is required by the state (e.g., water cycle), and that most elementary teachers considered "water" strictly as a science topic. While teachers personally acknowledged the importance of conserving water and keeping source water clean, they continued to find that upper elementary students had little or no understanding of major water resources topics unless the teacher specifically integrates a wide range of water topics into the curriculum. For this reason, as well as successful festival work with upper elementary students, this age level was selected as the focus for the RiverXchange program.

RiverXchange was created to provide a free program that is fun, interesting, and easy to integrate into the normal curriculum. The hope was to motivate participants to explore water resources topics in depth. The program was originally designed to be carried out over eight months so that students spend more time developing a sense of pride and personal connection to their own river ecosystem, as well as a personal connection to a distant river ecosystem and the students who live near it. Today RiverXchange runs over the course of 3-4 months, as a response to the challenges of implementing a year-long curriculum with the ongoing demands on teachers and students time and requirements for testing and other curriculum.

RiverXchange began in 2007 as a pilot project of Experiential EE, LLC (under a services agreement with the New Mexico Water Conservation Alliance) and the National Great Rivers Research and Education Center, featuring partnerships between two fourth grade classes in Albuquerque, NM, and two fifth grade classes in Godfrey, IL. A curriculum was developed, a field trip to the river was coordinated, and partner classes "met" three times during the year via video tele-conferencing to present what they had learned.

After the pilot project, RiverXchange transitioned to a web-based technology called a wiki. This enabled the program to overcome limitations such as the high cost, availability, and time zone logistical issues associated with video teleconferencing – and easily involve more classes. The curriculum was updated to incorporate the writing component and classroom guest speakers were introduced to reduce teacher workload and bring up-to-date technical information into the classroom. In 2017, the program switched to a blogging platform called Kidblog, which is still being used today.

In 2012, ownership of RiverXchange transferred to Amy White of Orilla Consulting, LLC, who managed the program through July 2015. In August 2015, RiverXchange became part of the Ciudad Soil & Water Conservation District. In 2020, ownership and the trademark registration of RiverXchange® was transferred fully to Ciudad Soil and Water Conservation.

Since 2007, we have served over 18,500 students!

This year, the program featured the following components:

- Optional standards-based curriculum including hands on science and social studies lessons, as well as writing assignments
- KidBlog online posting and communication
- Partner class engagement support

- Teacher training on curriculum implementation and use of KidBlog
- Ongoing technical and motivational support
- Monthly newsletters to NM and out-of-state teachers
- End of year teacher survey
- Pre and post student surveys (NM only)
- Payment for teacher workshop substitute teachers (NM only)
- Coordination of at least four guest speakers into the classroom (NM only)
- Coordination of a field trip to the local river or important watershed feature (NM only)
- Field trip bus transportation payment (NM only)
- Field trip leadership and activity planning (NM only)

## Program Management and Financial Support

The program timeframe was July 1, 2018 through June 14, 2019. All components including fundraising, design, planning, implementation, and analysis were carried out by employees and contractors of Ciudad Soil & Water Conservation District, including:

Melissa McLamb
Erin Blaz
Jenny Lloyd-Strovas
Astrid Hueghlin

**Sponsors**

- Southern Sandoval County Arroyo and Flood Control Authority (SSCAFCA)
- Middle Rio Grande Stormwater Quality Team (MRGSQT)

**Sponsors provided a total of $56,157.11 in cash.**
**MRGSQT - $41,415.55 | SSCAFCA - $14,741.56**

Program expenses included:

- Substitute teachers for NM teacher workshops
- Teacher workshop space rental and meals
- Field trip bus transportation for NM classes
- Field trip portable toilet rentals for NM classes
- Technology services
- Office and educational supplies
- Coordination services (planning, implementing and assessing all program components)
- Trademark Registration Fees
- Rain barrel project funds executed by The Nature Conservancy

**New Mexico In-Kind Partners**

- Albuquerque Bernalillo County Water Utility Authority
- Bernalillo County - Public Works Division
- City of Albuquerque – Open Space Division

- City of Rio Rancho – Environmental Programs Office
- City of Rio Rancho — Parks, Recreation and Community Services Department
- Sandia Labs
- Sandoval County Cooperative Extension
- Southern Sandoval County Arroyo and Flood Control Authority

**In-Kind contributions totaled $82,115.32.** For NM classes, in-kind contributions included classroom guest speakers, field trip docents, planting materials, workshop space and computer lab use, and teachers' and students' time attending the presentations and field trips. For partner classes, in-kind contributions were not calculated this year. Sponsors and in-kind partners were recognized on our website and in presentations.

## Participant Selection

All 38 participating NM classes were fifth grade classes, distributed as follows:

| **Bernalillo County** | **Sandoval County** |
|---|---|
| North Valley Academy (3) | Colinas del Norte Elementary (5)* |
| Cochiti Elementary (3) * | Martin Luther King, Jr. Elementary (6)* |
| Duranes Elementary (1) * | Sandia Vista Elementary (1) |
| Georgia O'Keeffe Elementary (2) | |
| John Baker Elementary (1) | |
| Monte Vista Elementary (3) | |
| Seven Bar Elementary (5) | |
| Zia Elementary (4) * | |
| | |
| **26 classes, 607 students** | **12 classes, 325 students** |
| * Title 1 school | **TOTAL - 38 classes, 932 students, 40 teachers** |



## Curriculum

A component of RiverXchange is the hands-on optional curriculum, which is offered to all participating teachers. It was developed to help students reach for deeper meaning through hands-on learning and reinforce what they have learned through the process of writing on the blog. Over the years, we have developed a curated list of activities from the curriculum, along with reflection prompts specific to each presentation. Organizers strive to incorporate emerging water resources issues into the curriculum, increase networking opportunities for teachers, reduce teacher workload, and align the curriculum with public school curriculum priorities.

Each class learns about its own local water resources issues through hands-on activities, classroom guest speakers, and a field trip. Students write about what they are learning via a private educational website that can be viewed by their partner classes. The computer technology and writing components provide a unique opportunity to reinforce what was learned, increase student motivation to learn, and collect valuable metrics about student performance.

Through RiverXchange, students take pride in sharing their knowledge of the local ecosystem and learning from their peers about another river ecosystem. Comparing the two geographical areas gives students a broader understanding of the importance of a river ecosystem to human and other life. Students gain the unique opportunity to share personal experiences and ask questions about a distant place. Teachers feel this kind of personal connection is a big deal for kids – many of whom have never traveled beyond their city limits.

All activities are correlated to NM state standards and benchmarks for Social Studies. All activities (because they require that students communicate information on the KidBlog) address Common Core Language Arts standards for writing. Some activities also address Common Core Mathematics and Science standards. As mentioned above, RiverXchange lessons and curriculum support the NGSS and will be evaluated for full alignment to the NGSS, beginning with the presentation activities and field trip. Projected date of completion: May 2021. For a summary of the RiverXchange Curriculum, see Appendix 1. For a summary of the extension activities, see Appendix 2.



**Guest Speakers**

We coordinated at least three guest presentations to visit each NM classroom. In all cases, guest speakers were water resources professionals from local agencies. Topics included:

- watershed/nonpoint source pollution
- drinking water
- wastewater
- water and agriculture

**Field Trips**

The program requires that all classes attend at least one field trip to their local river or important watershed feature, which should incorporate a service learning component if possible. Throughout the winter and spring, students planted 539 native trees and helped restore critical riparian habitat along the Rio Grande in Albuquerque near Shining River Parking Area, Albuquerque Open Space.

# EVALUATION

## Blog Evaluation

### Engagement

Considerable effort was made to make the blog an effective resource and easily accessible to teachers. An instructional document was reviewed at the teacher workshop and made available to them to return to at any point. We also included links to curriculum and extension activities on their blog page, hoping that might encourage teachers to visit the blog more frequently. Additionally a monthly newsletter was sent out to encourage posting, with links to the instructional document and other helpful resources. Our aim was to continually remind teachers to post and make sure the information they needed was easily accessible.

Of our total number of classes, Kidblog was used by 71% of RiverXchange teachers this year and the number of blog posts ranged from 1 to 32 per class over the year. This is a similar rate of use to last year. Teacher feedback suggests that many still feel challenged about how to incorporate blogging into their classrooms as a lesson for students. One North Valley Academy teacher reached out directly for support and Erin Blaz visited his class to do an in-class tutorial of posting on the blog. This visit was highly informative as Erin was witness to some of the issues that occur from getting students onto the blog and submitting their work. However, other teachers still express that they think the blog is an important aspect to the program, as it allows students an opportunity to enhance writing skills, think critically and reflect upon what they have learned.

We ran a contest this year for creative and excellent blogging. We used a rubric to score posts for each class to determine the winner. While class use and posting was about the same as last year, this year posts were more creative and used a wider variety of media. Some favorites were videos using the changing river model, artwork that modeled stormwater impacts on a city and PSA's on poster boards that encourage water conservation. Two 1st place winners received $75 gift certificates to Acorn Naturalists, and five 2nd place winners received $25 gift certificates. The original 1st place prize was going to be a rolling river presentation or edible aquifer activity, but with school closures that was not possible.

Considering the likely need for online technology next year and teacher familiarity with the blog, RiverXchange will continue the use of Kidblog.



### Student Voices

Student voices rang loud and clear this year in support of conserving water, keeping trash and pollution out of stormwater and the importance of Rio Grande!

The following are examples are from this year's students:

**NEW MEXICO CLASSES**

Thank you for the presentation 😃.

What we learned was clean up dog poop, or if we don't the river will be contaminated water and will kill the fish. If you litter you can kill animals so we learned that we should CLEAN UP DOG POOP!

What can we do? We can put more trash cans and recycling bins, we can ban plastic stuff. We can save more water. The community can clean trash🗑️. We should make more electric cars🚗. We can stop pollution from happening in water 💧.

Hello Again! Today we'll be discussing a pretty fun topic. Storm water! A better name for storm water is polluted water! This is a bigger issue than lightning and thunder! ***We need to help save local rivers anyway we can!***

In our presentation, we learned how contaminated our river gets every time it rains. These things get in to our river and poison it...

1. Pesticides. Pesticides hurt our river by running into the Rio Grande, poisoning our fish and killing our algae witch is vital because the fish eat it!

2. Fertilizer. Extra fertilizer run into the Rio Grande because we put too much on same things with Pesticides! Any way the fertilizer does what it was meant to do under water. They make the algae grow too much and use up all the river oxygen, killing all the living things in the river!

3. Poop. All kinds of poop hurts our water! Cow poop, dog poop, etc. They release germs like E-coli into our water which is very difficult to filter out!

4. Factory oil. They harm our river by leaking or dumping their left over chemicals into the Rio Grande! The chemicals can harm the water in many ways!

5. Livestock. Livestock can harm our river by eroding the soil so we end up with slit and dirt all mixed in!

6. Trash. Trash is a very big factor. Trash floats through storm drains and blows in the wind to our river and kills fish because they swallow it.

There are a ***lot*** of things that pollute our water. We are not that happy about that.

Here are some solutions to the problems we have with our river pollution!

1. For your pesticides you can still put it on but just put the right amount on! The bag tells you how much to put on so put that amount on! Or you could use bug paper.

2. Fertilizer is the same. You can still use but just put the right amount on!

3. Pick up your animals poop! This will help decrease the pollution greatly!

4. You cant do a lot about the factory oils. But you can write letters to important figures asking to make dumping your chemicals in the river illegal!

5. How we can help the issue of livestock is, if you own livestock put a fence up around their pastures and living areas so they can not wonder down to the river and pollute it!!!

6. For trash the easiest solution to this problem is to not litter and if you do pick it up!!! But we have a bigger idea! We will try to get plastic water bottles banned in our school and try ***TRY*** to get them banned in New Mexico! Plastic bags were banned so why cant plastic bottles be banned to!!! We can write letters and try to get people involved in what we are doing!!!

**Trout**

The Bosque means forest in Spanish.People plant native trees in the Bosque because they don't regrow by them selfs.We all agree that  we all enjoy being at the Bosque because the feel of nature, planting trees, smelling fresh air, and helping the environment. Aswell as having the feeling of after planting a tree.we all felt proud, exhausted, and seeing the planted trees was beautiful.Our class planted 17 trees!We all love the beautiful nature aswell. We recommend going to the bosque because you can ride your bike around or walk and see the sights, the smells, and the feeling.There are animals there too! Like fish, squirrels, porky pines, eagles and turtles. It is worth going to the Rio Grande.

Feb 27, 2020, 1:34pm (209.189.162.95)  Edit | Remove | Reply | Approve

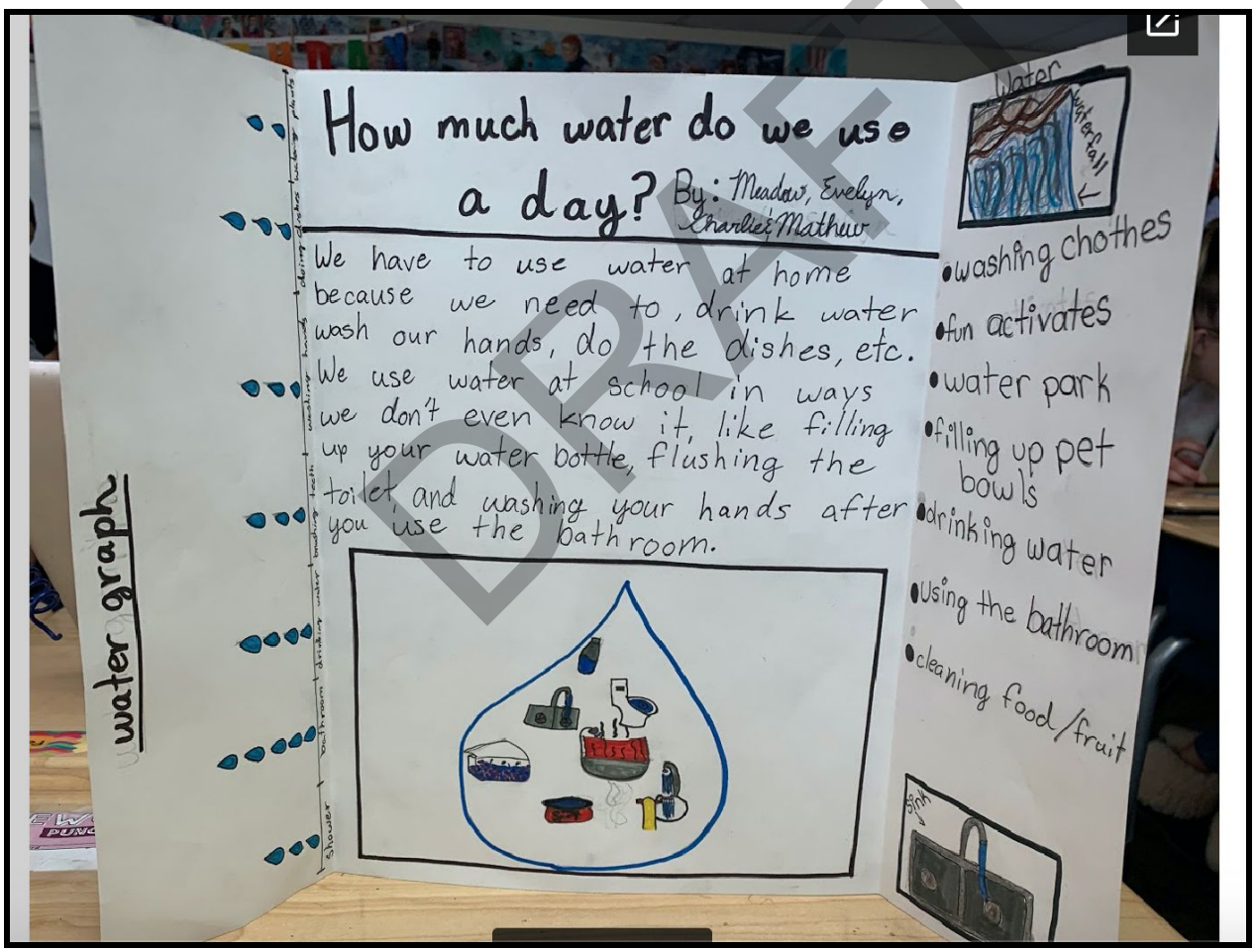


This image shows how everywhere that you go, you'll always see pollution, stores, neighborhoods, schools, farms, anywhere, you'll always see pollution. Not only will you see trash as pollution, you can see chemicals or polluted liquids like, Oil, Gasoline and Sewage. You can also see smoke from factories and animal droppings! We should always try to be responsible and try to stop throwing our trash on the roads.

# save the planet

By Irrigation Insiders on Nov 20, 2019

So I want to write this because we need to save all the beautiful animals that are being affected by pesticides and cow mi-newer.Did you know that point source pollution is were you can see the point that the pollution is coming out of.Non point source pollution is were you cant see or don't recognize it like pesticides and animal wast.In concoction don't use pesticides.



## Waste Water

By Snakes on Jan 9, 2020

We learned about waste water presentation. There is a bar screen that catches every thing that clumps up that goes down the drain or toilet. Even though there is flush-able wipes your not supposed to flush them down the toilet because they can clog your toilet. Every thing that you flush down your toilet ends up turning into sludge. Waste water goes to a waste water facility and once it's cleaned it goes back into your house to be used as waste water again. A machine that cleans the waste water is called a clarifier and how the clarifier works is the waste water goes into a huge bucket and a metal arm skims the top of the big bucket of waste water and picks up the trash and waste. The last part of cleaning the waste water is called a digester, it injects chlorine into the dirty water and once that is done and the water is clean they relies it back into your homes.



## Pole Planting

By Snakes on Mar 9, 2020

We went on a field trip to plant cottonwoods. We planted them because older trees are dying and we don't want them to die out. We used augers to dig the holes for the cottonwoods. We had to dig holes 10ft to 12 ft deep to get to the water line and so the trees can take root. We split into teams and took turns twisting the augers. When we pulled the augers up from the ground it was heavy because of the dirt. As we got down to the mud it was even heaver. When we thought our hole was deep enough we would yell "tree check." The conservation officers would come and see if our hole was deep enough. The poles were limbs from older cottonwoods. At the end we sat at the bank of the river and had lunch. In all we planted 39 poles. It was a great learning expirience.

**PARTNER CLASSES**

## Should you drink New Haven River Water?

By Quinby on Dec 6, 2019

After testing three different rivers for four different things. PH, Nitrates, Dissolved Oxygen, and Temperature, New Haven water is not perfectly clean, but still drinkable. After struggling through knee deep water, my class and I have established that water in New Haven is clean enough to drink, at least after you treat it. To go along with that, my class also used leaf-packs, nets with leaves in them, that allow animals to live inside of them. We put them in the Mill River, and retrieved them two months later. We found so many macro-invertebrates, it was hard to believe! We found a lot of Macro invertebrates that could only live in clean water, which means that they were group 1.

## FRESHWATER MUSSELS

By Wetland on Nov 25, 2019

Freshwater mussels live in streams they filter feed to stay alive.Freshwater mussels are related to water quality because.They filter feed and make the water clean.I learned that the mussels filter feeded and made the foggy dirty water clean.I learned how the mussels life cycle goes.They are born and spit onto fish gills when they are ready they are dropped and the mussels grow.`



## the housatonic river and long island sound

By Harbor Seals on Dec 6, 2019

the housatonic river starts in massachusetts  and goes into long island sound. There are a lot of things to do in the housatonic river like fishing and activities  like hunting for animals.There are alot of types of fish in the housatonic river like the striped bass,brown trout,blue fish,white perch,mouth bass,sea bass and many others.

## Student Evaluation

A key component of RiverXchange is measuring student learning outcomes. We collect quantitative data on learning outcomes and behavior changes by way of a pre and post survey. We make qualitative observations by reading what students submitted on KidBlog. In 2019 we were able to compile comparative metrics from the last 4 years of RiverXchange surveys to observe the longitudinal impacts of our program. Working with a team, we continue to refine the survey questions to better reflect RiverXchange learning objectives, while maintaining the ability to track comparative learning outcomes across years.

### Pre/Post Behavior Survey

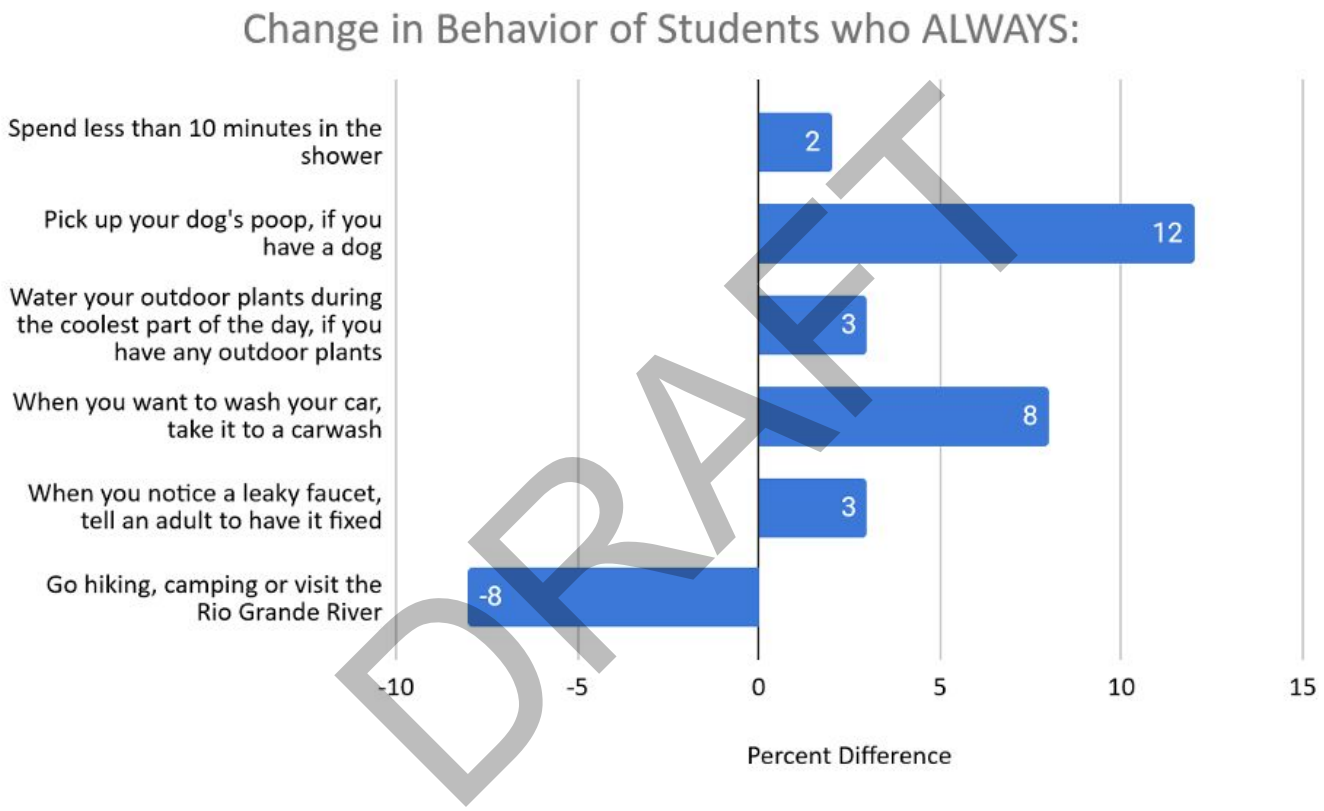
In order to quantify the learning outcomes achieved through RiverXchange, we ask our teachers to have their students fill out a survey prior to, and upon completion of the program. This year's survey was updated in summer of 2019 to reflect the suggestions for improvements that were identified at the end of 2018-2019. The survey went from 18 questions to 13 in an effort to be more concise and eliminate questions that were found to be irrelevant to programmatic impact.

Below, you will find a series of graphs used to illustrate the change in responses between the pre and post surveys. This year, 795 students completed the pre-survey, while only 410 completed the post-survey. This was due to school closures occurring right after post-surveys were distributed to teachers. Most students completed the survey from home. In order to account for the discrepancy in participation, the number of each given answer has been calculated as a percent of the total number of responses received for each given survey.

The metrics demonstrate an overall positive increase in students' knowledge about local water resources, water conservation strategies, and human impacts on water quality. After participating in RiverXchange more students correctly defined a watershed, the annual precipitation in our region and the origin and outlet of the Rio Grande. In reviewing the graphs, notes were made below on findings that were significant, or on areas where the survey needs to improve. The first question below aims to understand how students' water conservation and environmental behaviors change after taking the program. The final question highlights some responses from the open ended question: *Do you think everyone has a right to water and why?* You will find some passionate, thoughtful, and critical responses that tell us that even if they don't fully understand what happens along the stormwater pathway yet, they overwhelmingly understand that water is life and has to be protected.

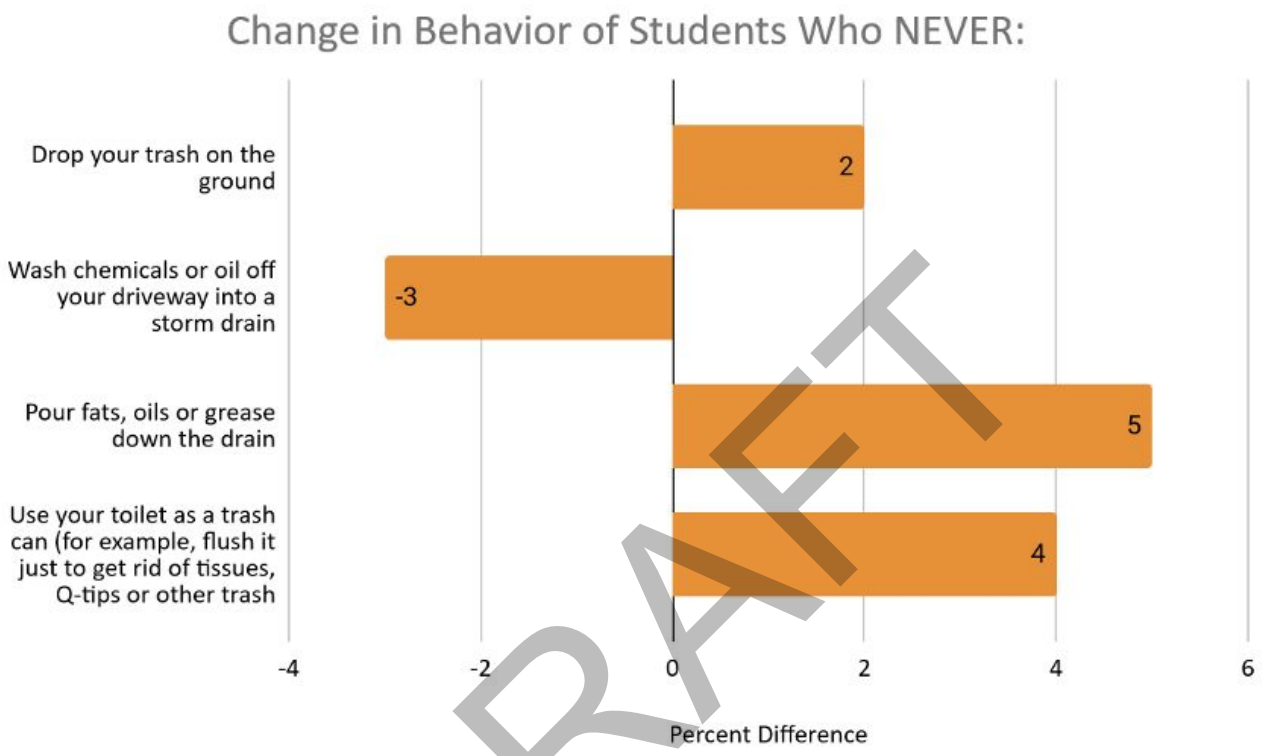
**Item # 1: How Often questions**

The following two graphs demonstrate the percent change in responses on questions that reflect positive and negative behaviors in regards to water consumption and conservation. The questions are framed as "How often do you…?"





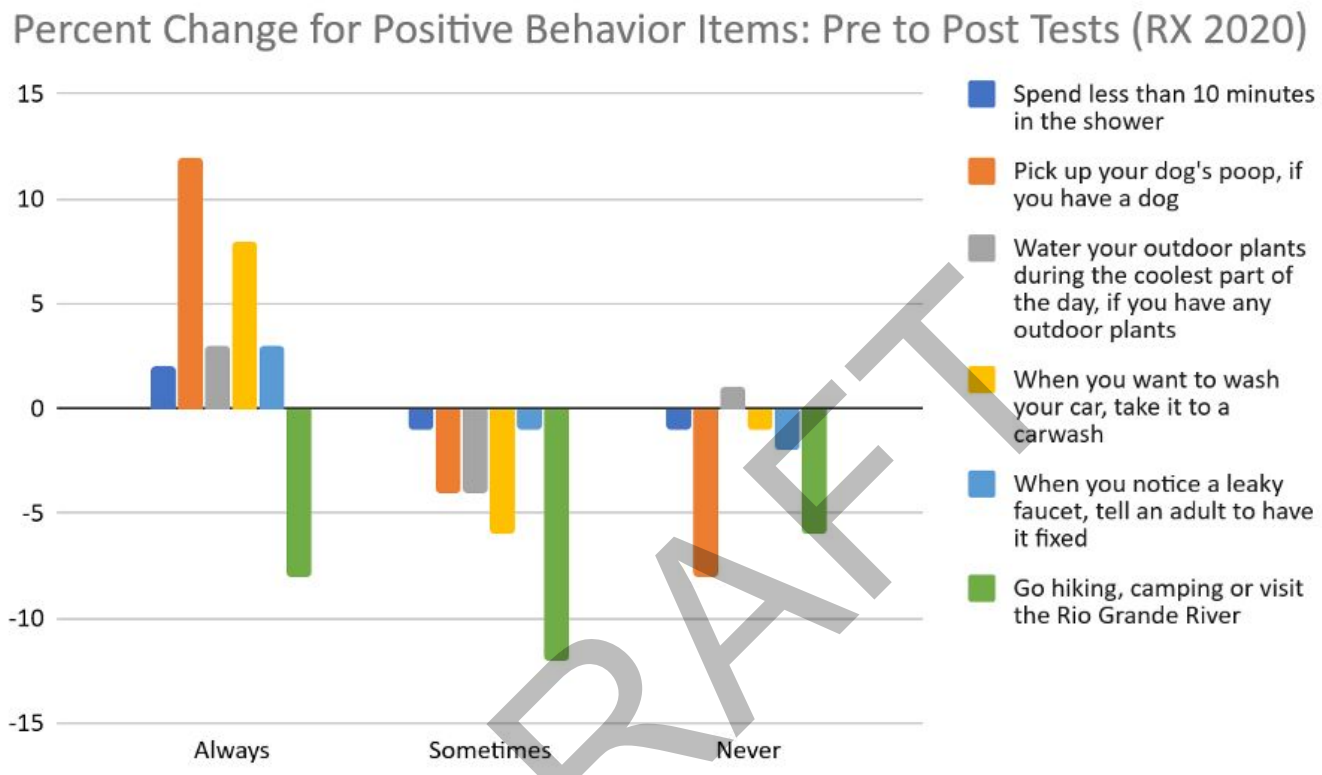

- After going through RiverXchange, 12% more students said that they pick up their dog poop ( i.e. 12% more students said they learned from the program and report to have changed behaviors from the pre to the post test). However, in the pre-test, more students reported going hiking and visiting the Rio Grande than those who reported this behavior in the post-test. Two considerations are taken into account for the negative percent change in students reporting camping, hiking or visiting the river. One is that the stay-at-home order might have impacted their response and students are answering literally not in the context of normal family behaviors. Another is that once students participate in the pole planting field trip, where they walk a good distance to the river and find themselves surrounded by nature without a house in site, they might reconsider their initial answer with a different perspective on what it means to visit the river.





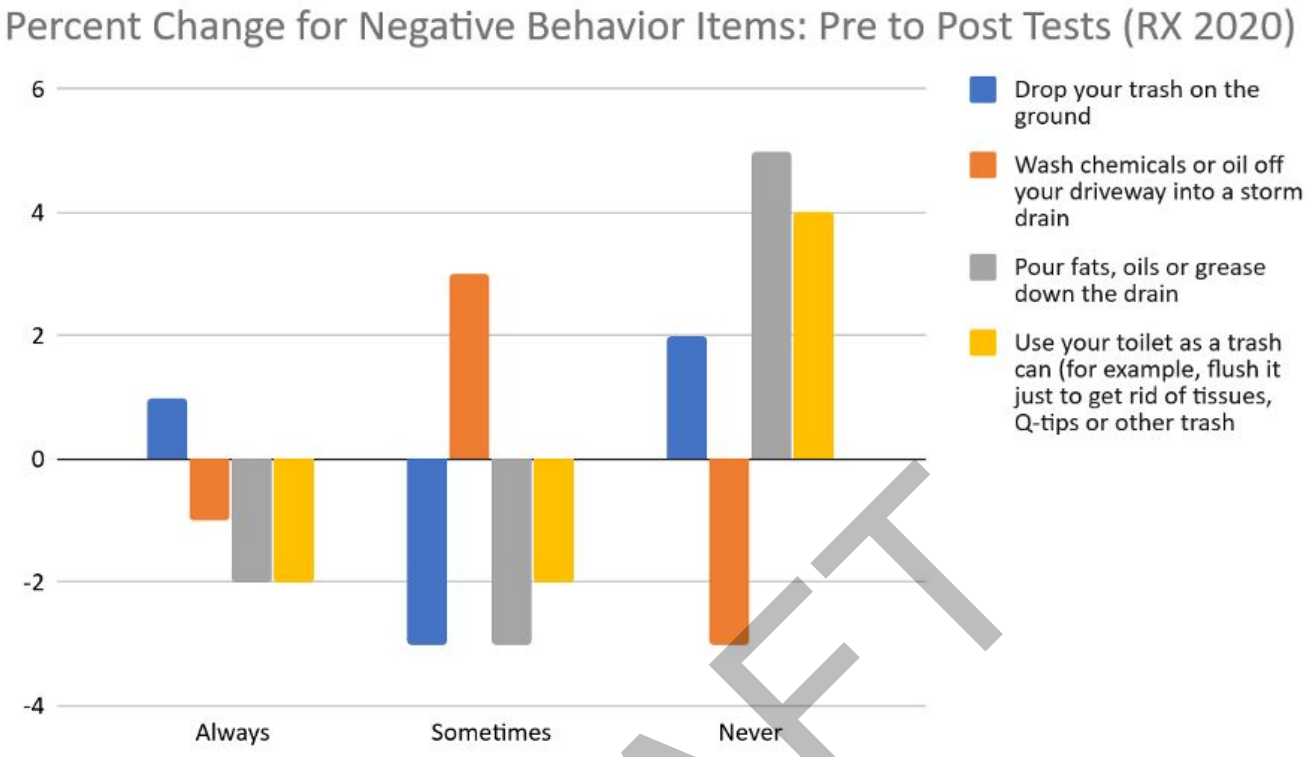

- In the post-test, 5% more students reported to NEVER pour fats down the drain. This means that they gained valuable information from RiverXchange and report to change their behavior (likely because of the program itself). However, we see that more students reported to NEVER wash chemicals or oil off the driveway into a storm drain in the pre-test than they did in the post test, resulting in a negative number. Likely, this is just due to error since it's such a small percentage and that there was really no change.

The following two percent change graphs include the ‘sometimes’ option for the ‘How often’ questions:





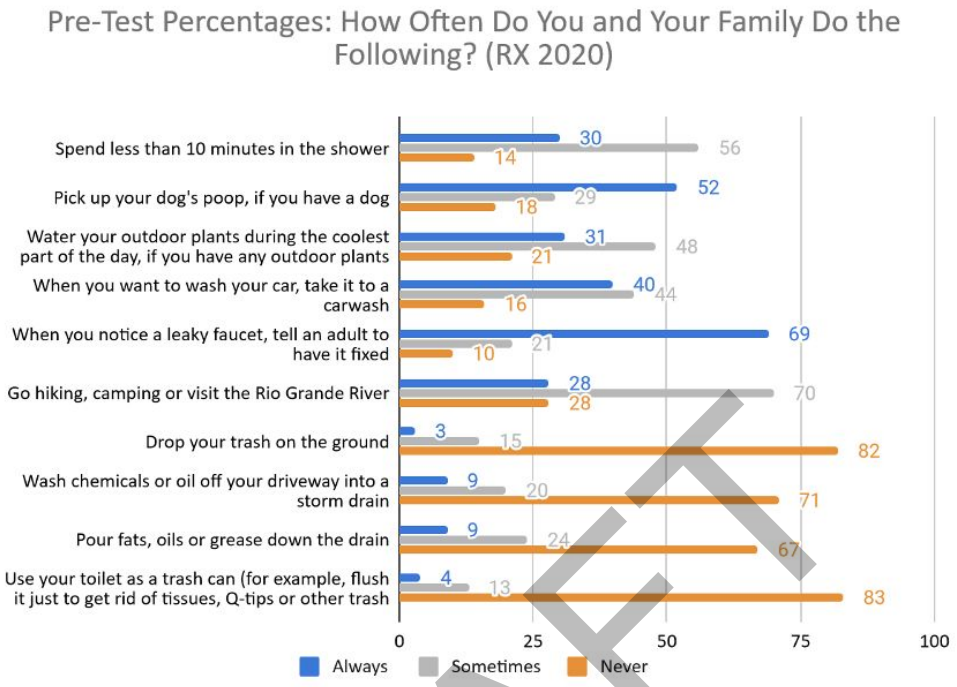

- Again, the most significant change is more students saying they always pick up their dog’s poop. However, it appears that both ‘sometime’s’ and ‘no’ answers decreased slightly, meaning that some students' behaviors changed for the positive.



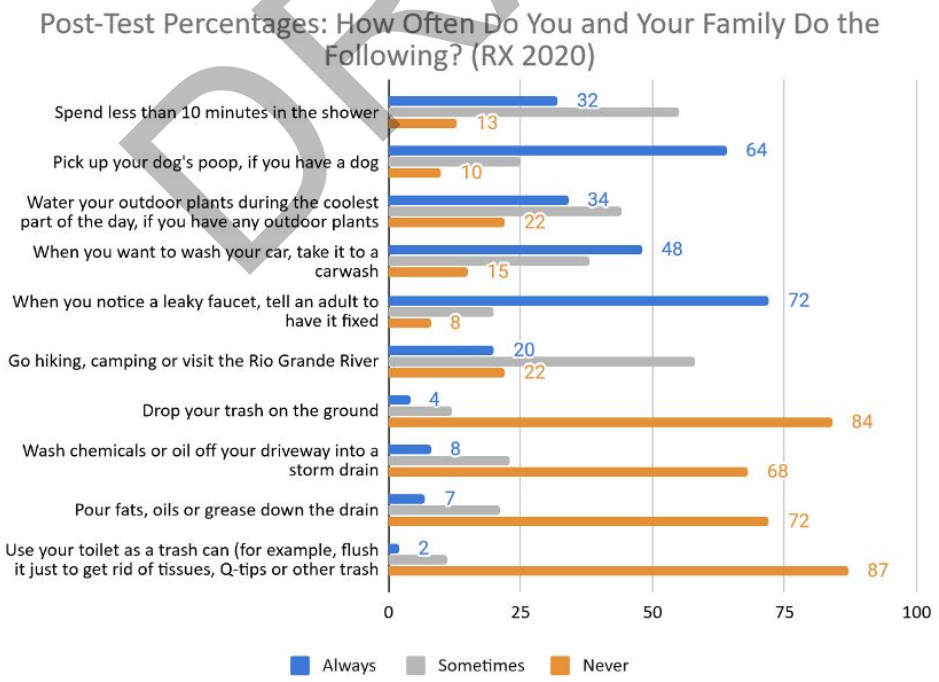



- The increase in responses from never to sometimes "washing chemicals into a storm drain" is interesting here. This may be a case of students answering more honestly if they observed or participated in this at home after they learned about stormwater pollution.

The following graphs are the raw percentages for the pre and post *how often* survey questions:

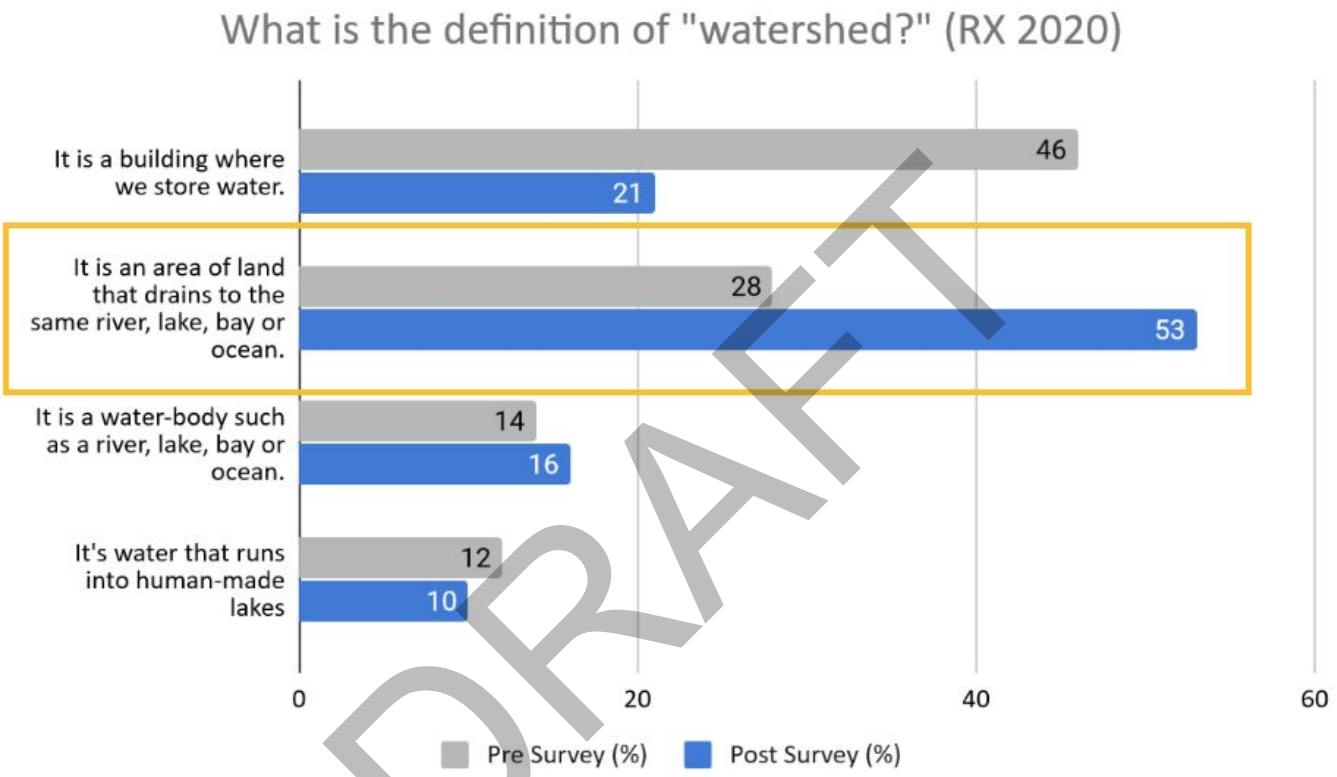




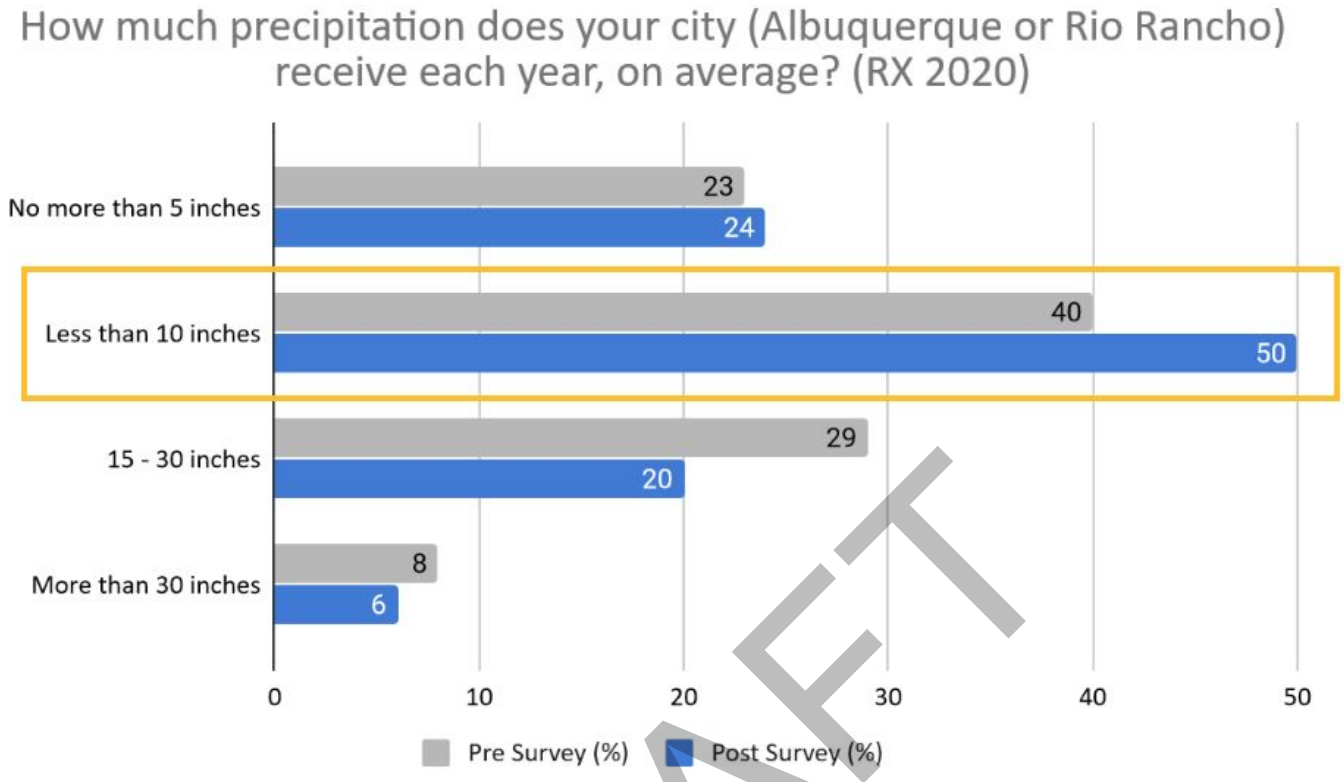



The next section of survey questions correspond to the learning objectives of RiverXchange and demonstrate student learning outcomes from pre to post evaluation. Correct answers, where applicable have been noted with a yellow outline or stars.

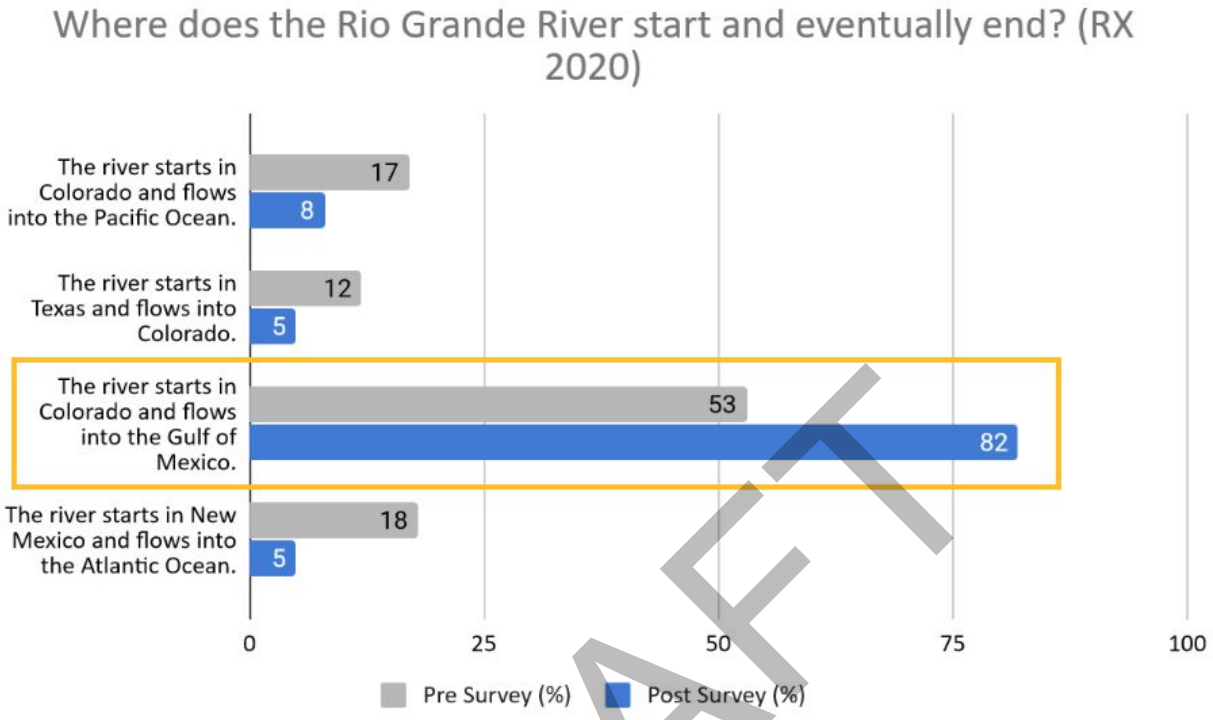
**Item # 2: What is the definition of a "watershed"?**



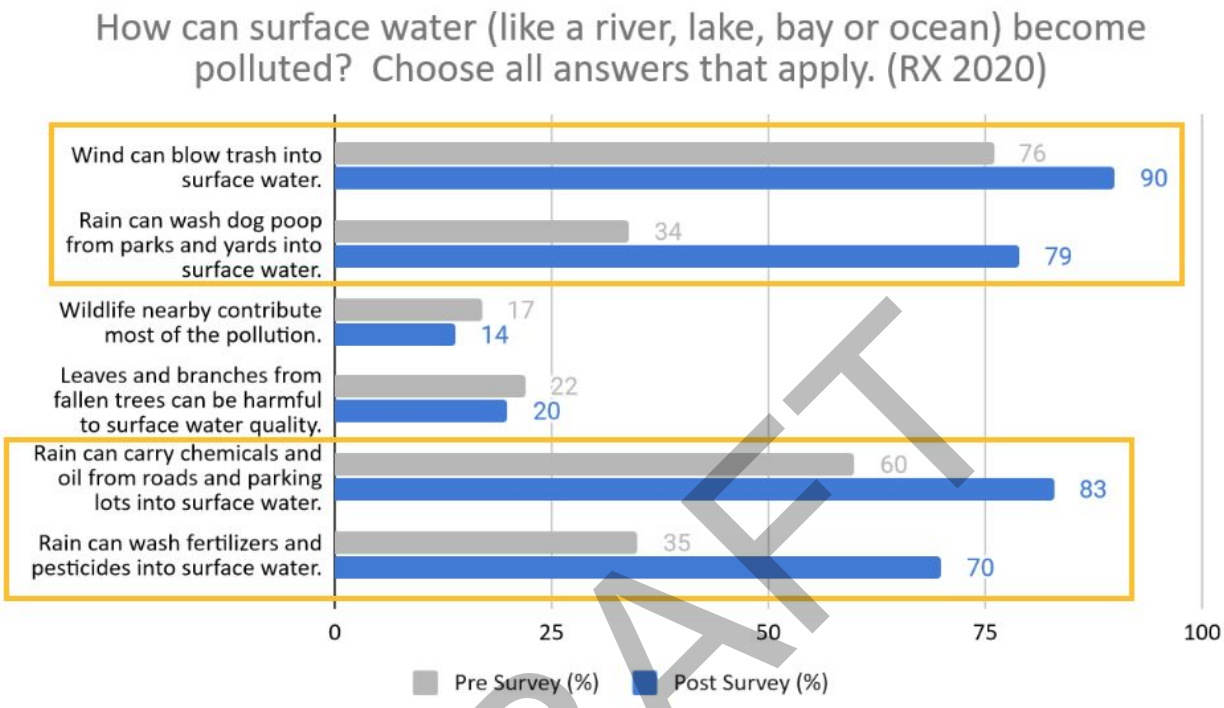
**Item #3: How much precipitation does your city receive each year on average?**



**Item #4: Where does the Rio Grande River start and eventually end?**



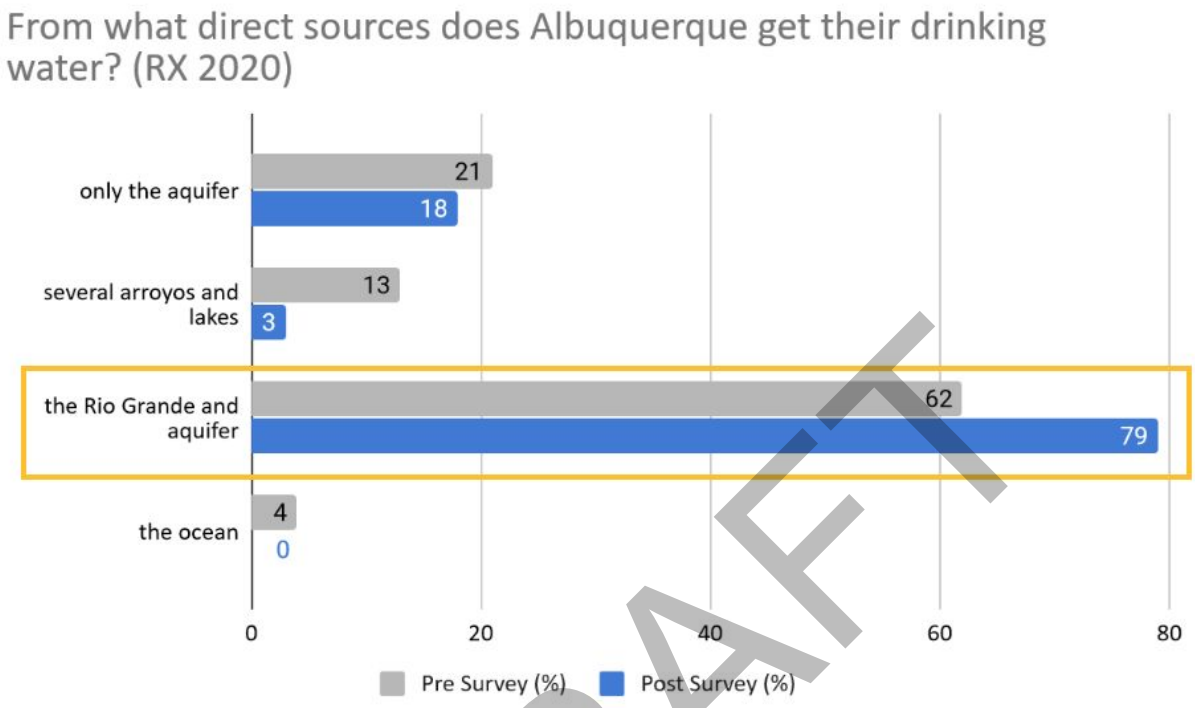
**Item #5: How can surface water become polluted?**

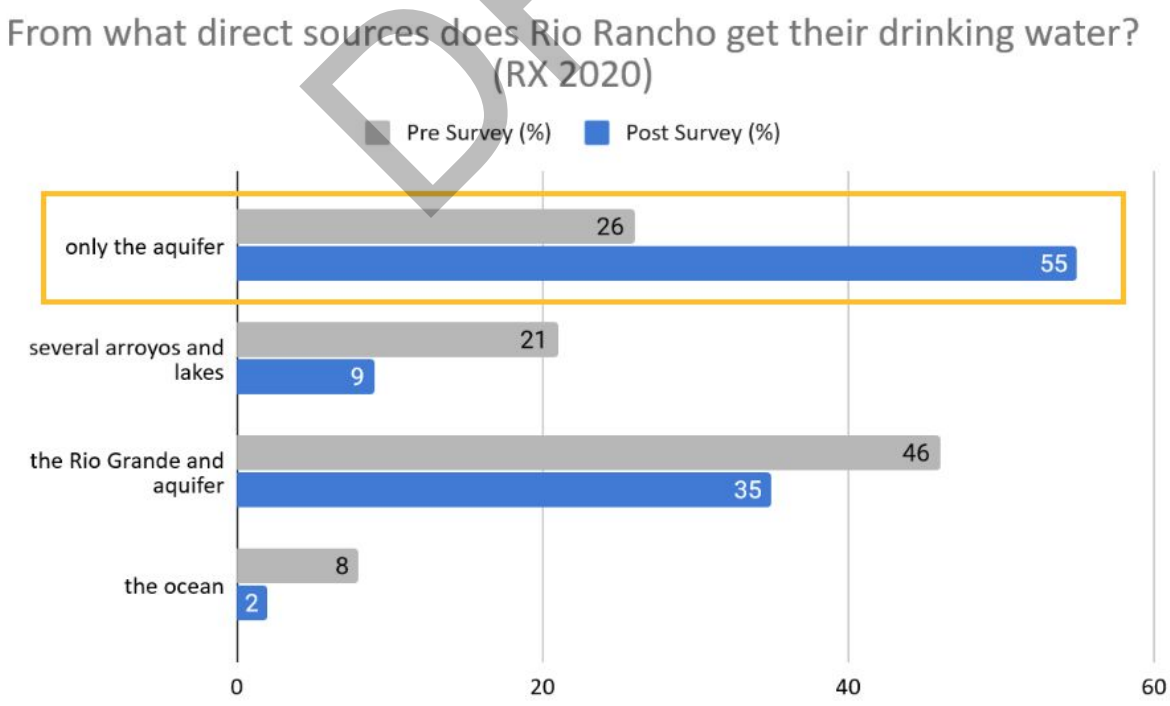




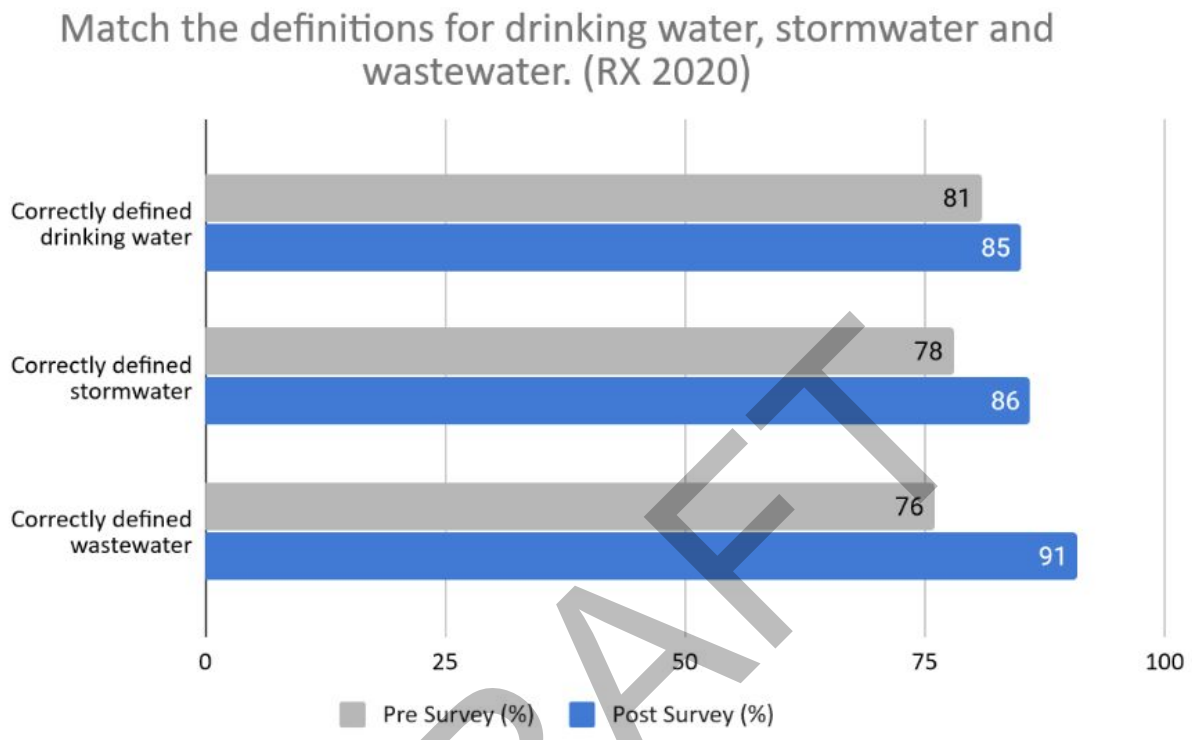

- Responses to this question were adjusted from last year to remove "all the pollution comes from factories" and "all the pollution comes from just a few people" as those answers seemed too obvious. Since this question allows for multiple responses, students who choose the incorrect answers are likely also choosing correct answers. We do see a reduction in the incorrect responses from pre to post survey. With the change in responses it may mean that our stormwater presentation may also need to incorporate some myth busting as well to clarify the incorrect responses.

**Item #6: From what direct sources does ABQ/RR get their drinking water?** Students are directed to only answer the question for the city in which they live.



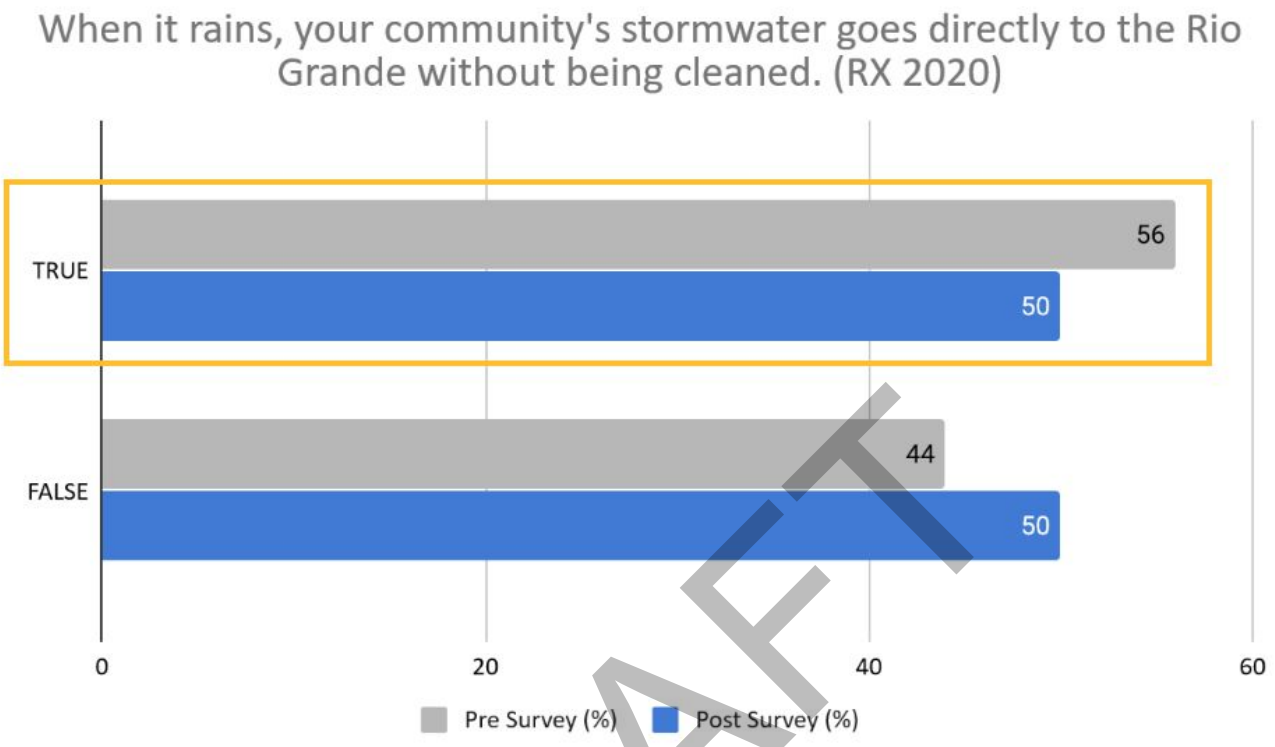



**Item #7: Match the definitions for drinking water, stormwater, and wastewater.**




- The responses to this question do not suggest RiverXchange teaches these definitions to students as it may already be prior knowledge, although it may be that it is clear enough in the descriptions that students can easily choose answers correctly. We will explore if there is a better way to evaluate if students understand concepts that are taught about drinking water, wastewater and stormwater.

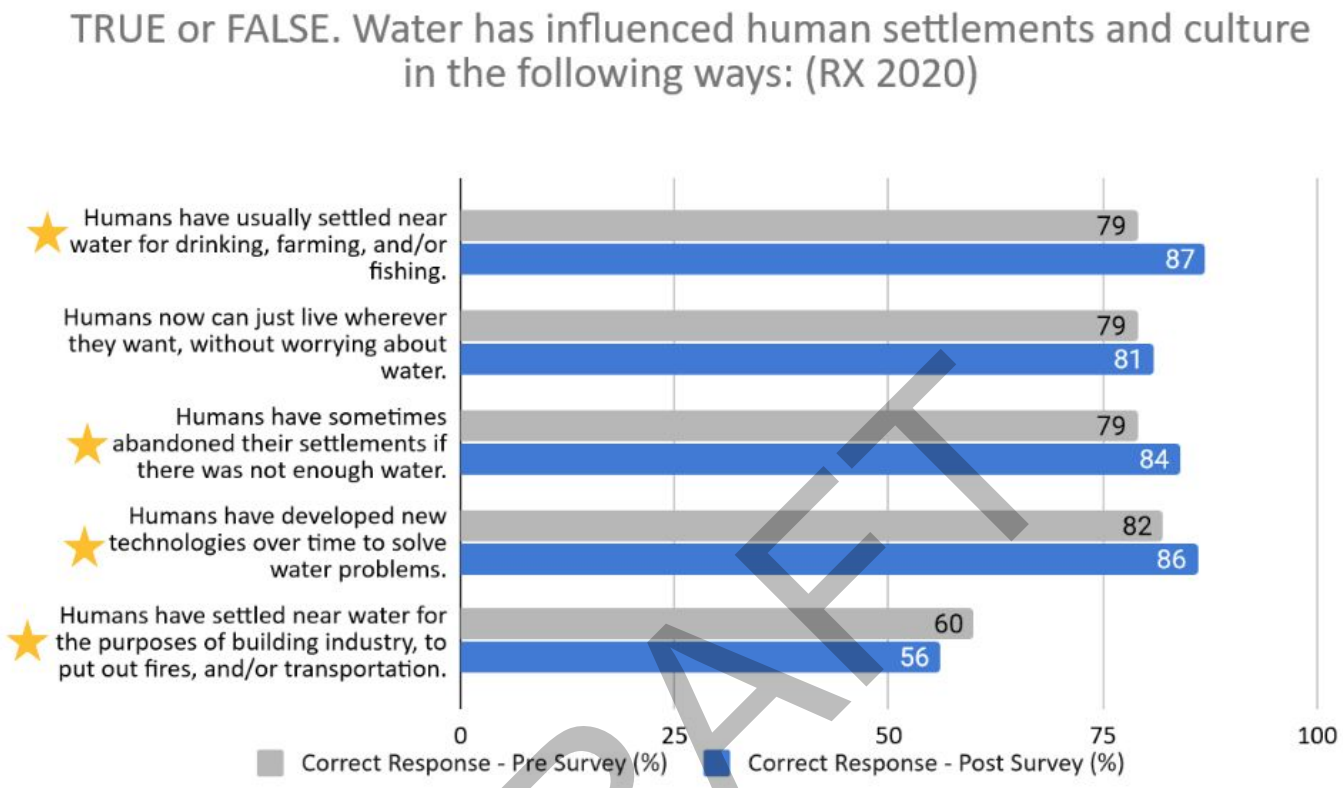
**Item #8: When it rains, your community's stormwater goes directly to...**






- This graph demonstrates a small decrease in correctly defining the stormwater pathway. This continues from last year, as we saw a similar percentage decrease in the correct answer. We met with presenters prior to program implementation this year and shared the concern about this misunderstanding and that it may be rooted in misinformation or confusion about a sewer drain versus a stormwater drain. However, we are still seeing similar results. It may be that there is confusion about a storm versus sewer drain. It could also be that presenters are discussing green stormwater infrastructure techniques that might lend students to think it is cleaned. They may also be another variable that is influencing this result that we have yet to identify.

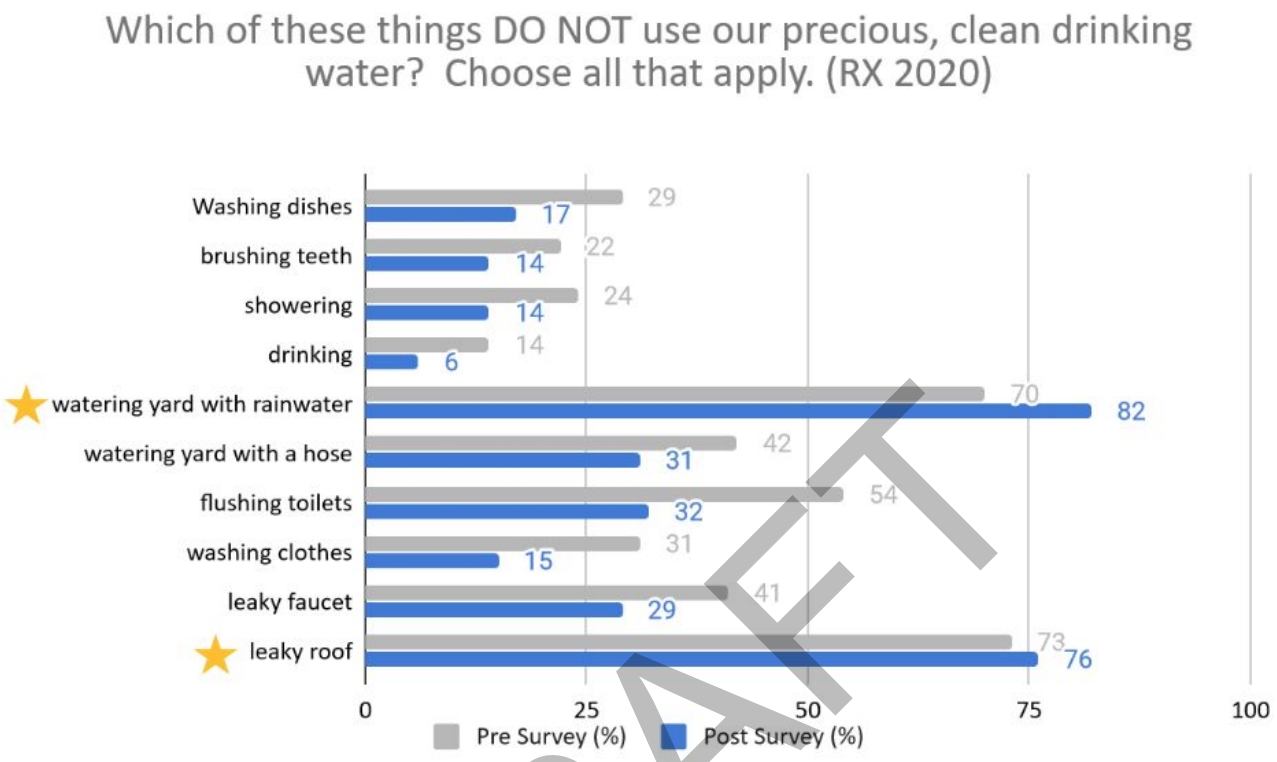
**Item #9: Water has influences human settlements in the following ways:**






- This question was adjusted from last year to allow students to choose true or false for each response, rather than only picking true answers. We see students are answering correctly in high percentages on the pre-survey but there is still positive growth for each answer, except the final "Humans have settled near water for the purpose of…" This could be the result of the changes made in the APS agriculture presentation that highlights the historical and cultural uses of the Rio Grande with a focus on Puebloan and Spanish settlements. The discussion does not always reach modern commercial uses of rivers that are more relevant to waterways outside of New Mexico.

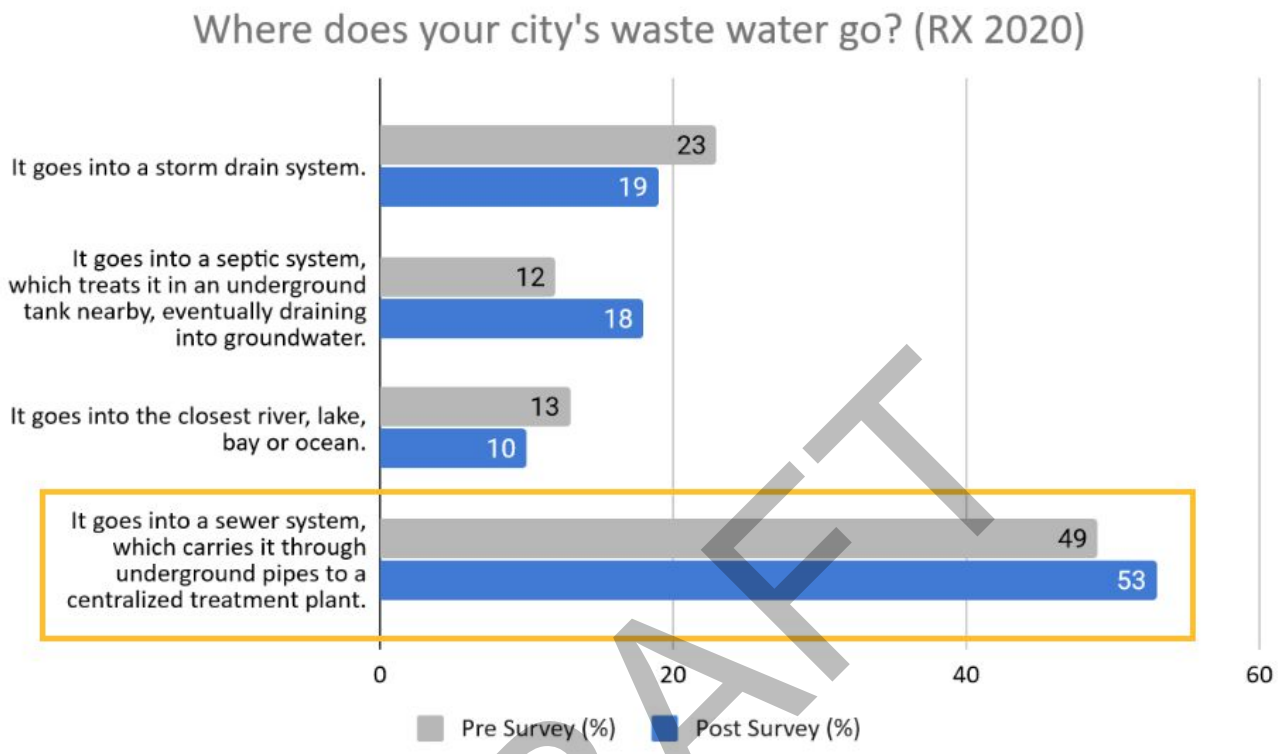
**Item #10: Which of these things DO NOT use our precious, clean drinking water?**






- This graph suggests that after participating in RiverXchange it was further clarified how often we use clean drinking water in our daily lives as the incorrect responses were reduced by 8-22 percent.

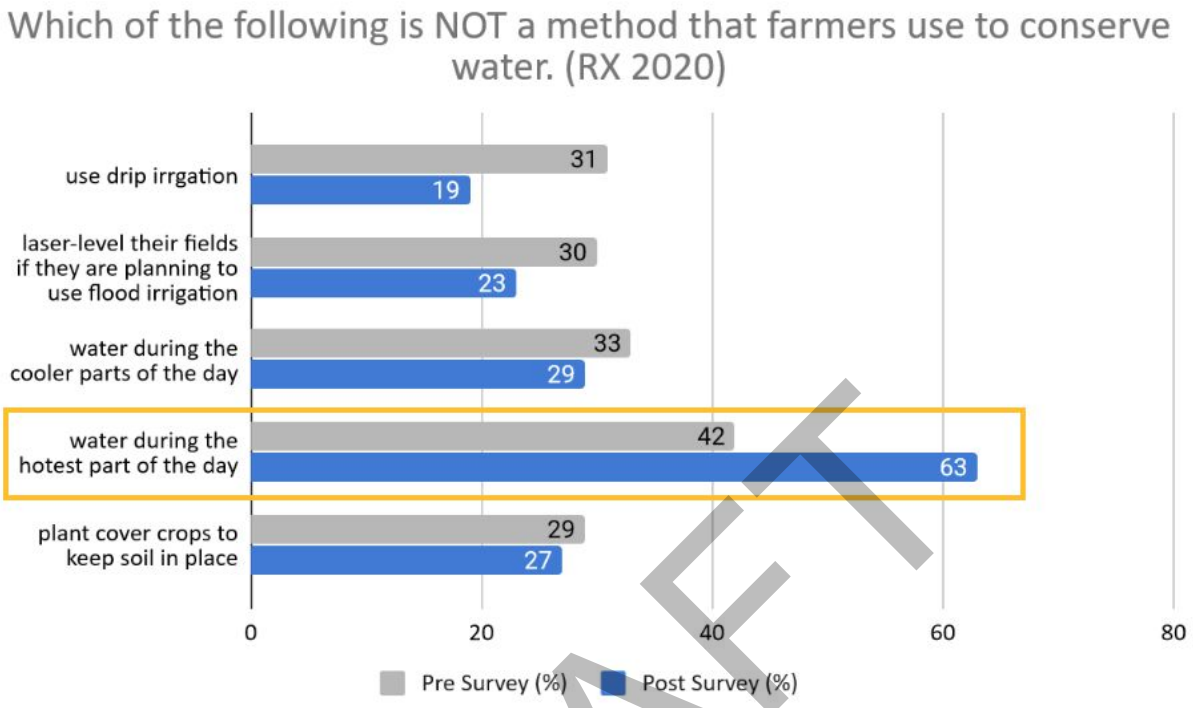
**Item #11: Where does your city's wastewater go?**





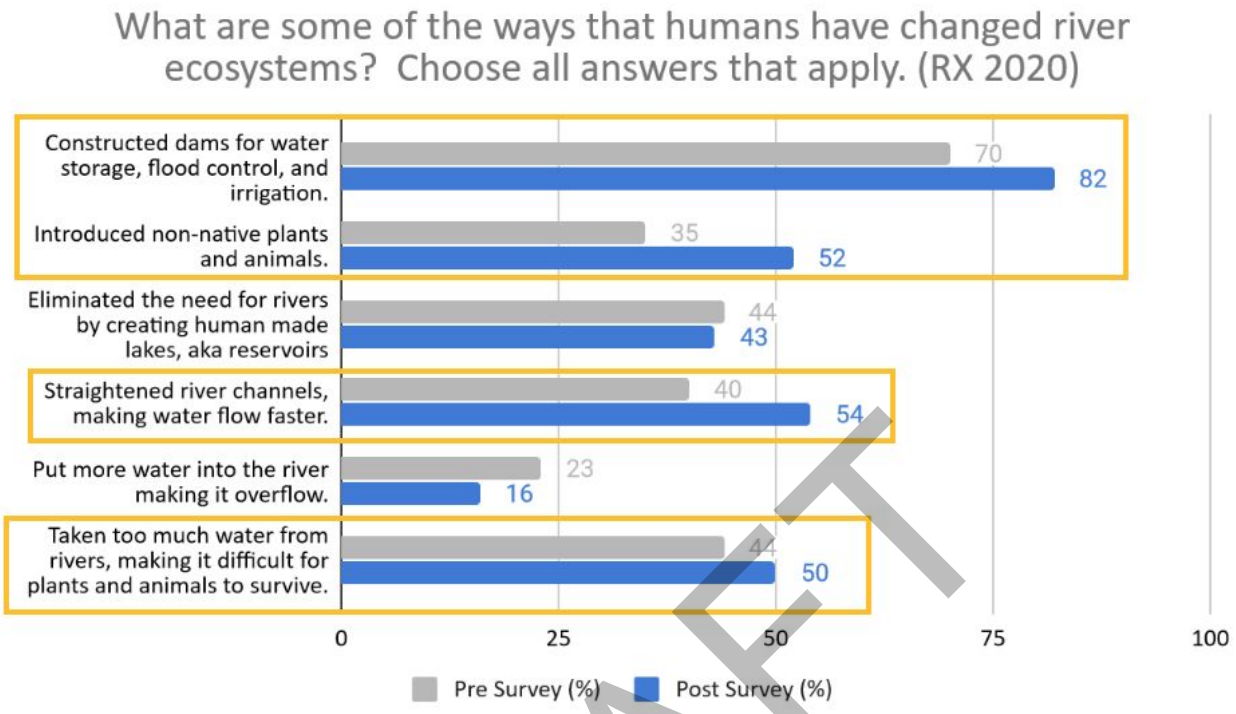

- This question was updated from last year's "When it rains, where does your community's stormwater go?" as the answer changes depending on where students live. The hope was that asking where your city's wastewater goes would prompt students to remember that Albuquerque and Rio Rancho have centralized treatment plants for the majority of residents. Considering that both incorrect answers saw a reduction in responses demonstrates that students are understanding that wastewater is either cleaned at a treatment plant or goes into a septic system (as is the case for many Rio Rancho students).

**Item #12: Which of the following is NOT a method farmers use to conserve?**




- Water conservation strategies for different farming methods and irrigation systems were only covered in the Sandoval County Extension agriculture presentation with Rio Rancho schools this year. Moving forward this question may need to be redefined or removed to account for the different presentations in each district.

**Item #13: What are some ways that humans have changed river ecosystems?**






- Overall this graph demonstrates that students increased their understanding of human impacts on river ecosystems. It is notable that their understanding of the impacts from the introduction of non-native species, straightening the river, and building dams significantly increased. The field trip experience really drives home a lot of key concepts about the Rio Grande's timeline and how anthropogenic influences on the river have impacted the riparian ecosystem.

**Item #14: Does you think everyone has a right to drinking water and why? (short answer)**

"Yes Everyone Has A Right To Drinking Water Because They Are Living Creatures They Need Water To Survive."

"I think everyone should have a right to clean drinking water because water is a necessity to life."

"Yes. If not everybody has water, then the human population will die off. I think that everybody should have access to water, especially in places where they don't have access to supplies of water."

**"yes, I think that all people have the right to clean drinking water because humans need water to live and survive and people do have the right to live off of clean water for everyday use. Also all people should be treated fairly when it comes to drinking clean fresh water."**

"Yes! I think this because the government can't be like you don't have money for us so you can't have water. That is basically starving them"

"Yes I do. I think this because everyone needs to drink water to survive and the water they drink should be clean so that they don't get sick or get a disease."

"I think everyone has a right to drink clean drinking water because if we drinker dirty water, we would be like Mexico because in Mexico, the only water they drink is dirty water and the people who live there often get sick by the water."

**"I think everyone doesn't have a right drinking water because some states have no clean water they still have water, but it's not all clean. Some people get sick from drinking dirty water all the time because there is no clean water."**

"This is a yes and no question for me. I don't believe that people that waste our water should have any, but than again everyone needs water to survive. So I do think that people should have it because they need it, but some people just don't deserve it."

"Yes , I think that everyone should have the right to have clean drinking water . As long as people don't waste it people should have it , and be great full for it to ."

"I think everyone has a right to drinking water but, some places in the world are really dry, so it's hard to find clean, decent drinking water."

"Everyone of every race and country has the right to drinking water because it is a source of life and everyone in the world deserves it."

**"I think everyone has a right to drinking water because, in order to live as humans and as a community, we must have water. Water is life! But I also think everyone has a right to know how to conserve it!"**

"Every one has a right to drink water because no one owns it"

Appendix 1 includes the extension activities from the RiverXchange curriculum, Appendix 2 includes photos.

# Appendix 1
# Extension Questions and Activities

## Understanding Our Watershed:

## *River Geography*




- **Suggested Reading:**
  - **Books:**
    - *Follow the Water from Brook to Ocean* by Arthur Dorros
    - *Paddle-to-the-Sea* by Holling C. Holling
    - *One Well: The Story of Water on Earth (CitizenKid)* Strauss, Rochelle
  - **Articles:**
    - *Albuquerque Journal:* "As Bad as it Gets: Drought Returns to New Mexico."
    - *Albuquerque Journal:* "Drought Affecting 99% of New Mexico."

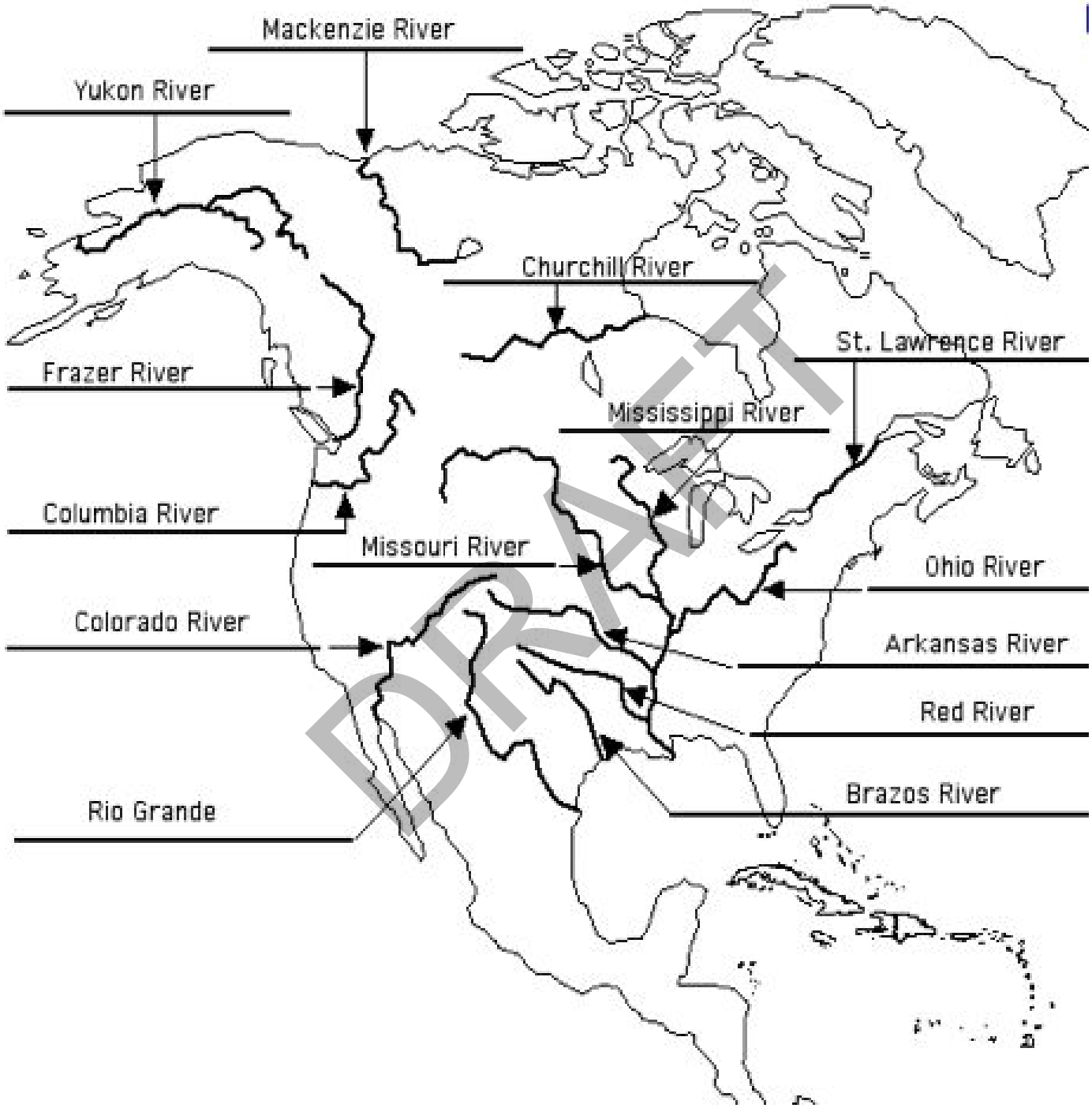
- **Watch:**
  - Watch Save Water - Save Our Rio!, a 17 minute video created by local summer camp students, sponsored by Albuquerque Water Utility Authority. Follow up with *When is the Drought Out?* http://www.abcwua.org/education/pdfs/Drought_GraphingOption.pdf

- **Write a letter to your partners or create a project, explaining:**
  - what a watershed is
  - the name of your river - this is also the name of your watershed!
  - the journey of your river from its headwaters to the ocean

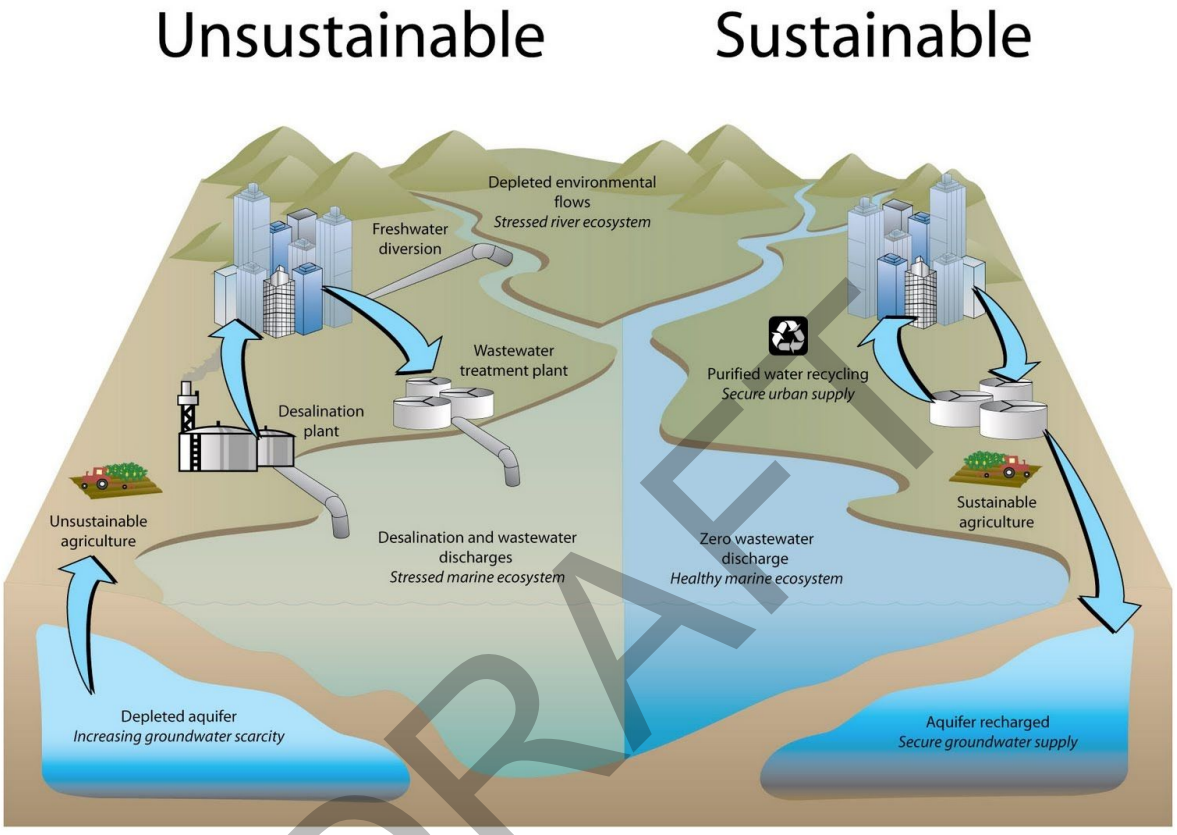
- what the river is like in your area - big/small, clear/muddy, fast/slow?
- how much precipitation your area receives each year, and what season gets the most precipitation

- **Want to explore further?** Refer to Project 1 in the RiverXchange Curriculum "Understanding a Watershed".
  - You can access the curriculum on your Kidblog homepage or by following this link: https://riverxchange.com/teachers2/curriculumpage/

# North American River Map



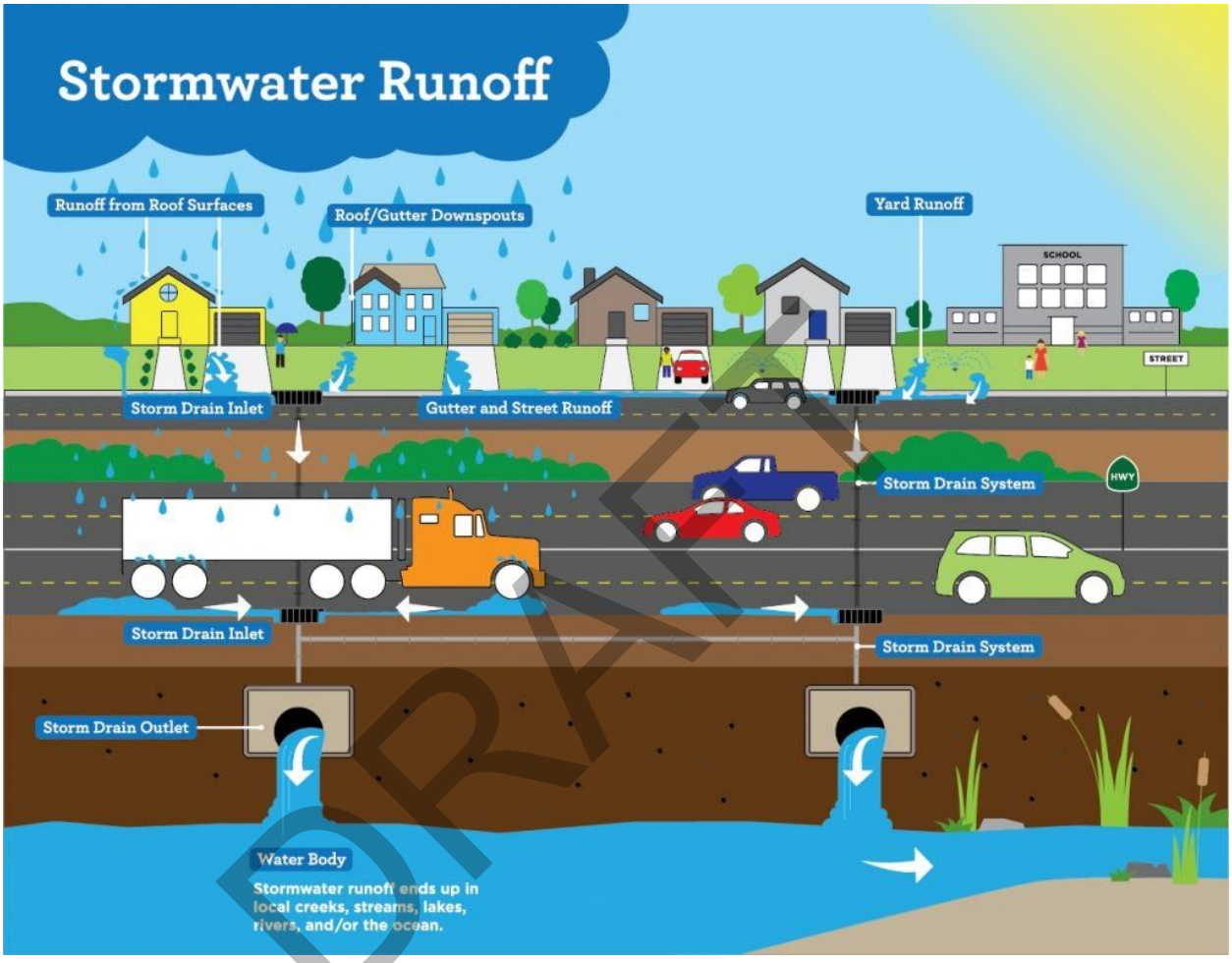
# The urban water cycle




Clean Ocean Foundation 2009 - www.cleanocean.org

**Understanding a Watershed:**

# *Watershed Model / Infiltration and Runoff*






Graphic credit: City of Columbia, MO

**Enhance your student's blog posting and extend their learning beyond the Stormwater presentation with the following activities:**

- **Suggested Reading:**
  - **Articles:**
    - *CNN* article. 2013. "Garbage Man of the River" http://www.cnn.com/2013/04/18/us/cnnheroes-pregracke-rivers-garbage
    - *Science News for Kids* article. 2012. "Suffocating Waters" https://www.sciencenewsforstudents.org/article/suffocating-waters
- **Watch:**
  - *The Human Solution to Water Pollution* video (to right of screen): http://sscafca.org/teacher-resources/
  - *The Majestic Plastic Bag* video (mockumentary): https://vimeo.com/14221747
    - For a 60 minute class activity, include this lesson to explore the Great Pacific Garbage Patch and what students can do to respond.

- Explore The Ocean Cleanup project and how an 18 year old started with a simple idea which is now making a difference in the effort to clean up the world's oceans.

❖ **Explore your watershed**

➢ Follow the link below to zoom in and explore your watershed and the watershed that family and friends live in, perhaps even your RiverXchange partners who live outside of New Mexico! Interactive Topographic Watershed Map of Earth

❖ **Lesson plan**

➢ *Don't Trash Our Rio Activity Guide* - A math based extension where students learn how much trash is pulled from Albuquerque's storm drain system yearly, and calculate how many trash bags or classrooms it would fill. (Follow links for additional handouts)

- **Reflection Questions**
  - Discuss how the gutters in our streets lead to **storm drains**, which often lead directly to the nearest body of water. Discuss the difference between **stormwater** and **wastewater** (from household drains and toilets).
  - What is stormwater and where does your community's stormwater go?
  - What did you learn about stormwater that was surprising to you?
  - How do things that happen in your yard or your neighbor's yard impact the watershed?
  - What have you noticed about stormwater in your own neighborhood?
  - What are some things you can do to clean up stormwater?
  - How can surface water become polluted?
  - What's happens when rain falls on a pervious surface compared to an impervious surface? Give examples of impervious surfaces.
  - How are groundwater and surface water connected?
  - What are ways you can minimize stormwater pollution?

❖ **Want to explore further?** Refer to Project 2 in the RiverXchange Curriculum "The Watershed".

➢ You can access the curriculum on your Kidblog homepage or by following the link below: https://riverxchange.files.wordpress.com/2018/09/riverxchange-curriculum-20181.pdf

**Water in Our Society:**

# *Drinking Water*



**Enhance your student's blog posting and extend their learning beyond the Drinking Water presentation with the following activities:**

- **Suggested Reading:**
  - **Book:** *A Long Walk to Water*, by Linda Sue Park (2010: Clarion Books)
  - **Articles:**
    - **Albuquerque drinking water info**
      - from ABQ Water Utility Authority http://www.abcwua.org/education/pdfs/WaterUse_Text.pdf
      - About the San Juan Chama Project, ABQ Journal 2008: https://riverxchange.files.wordpress.com/2015/08/san-juan-chama-project.pdf
    - **Santa Fe drinking water info**
      - Buckman Diversion, ABQ Journal 2010: https://riverxchange.files.wordpress.com/2015/08/buckman-diversion.pdf
    - **Santa Fe drinking water info**
      - Buckman Diversion, ABQ Journal 2010: https://riverxchange.files.wordpress.com/2015/08/buckman-diversion.pdf

- **Lesson Plan: The Water Project**
  https://thewaterproject.org/resources/WaterLogs_5to8.pdf
  - Five simple activities and lessons to assist students in exploring how water scarcity may impact their lives and how they can contribute by conserving water.
  - Suggested activity: Students log their personal use and observation of other forms of water use over two days, then discuss their findings and explore what would happen if water scarcity were an issue. Another lesson also includes a TRUE/FALSE game to learn about water and how it impacts the human body and communities.

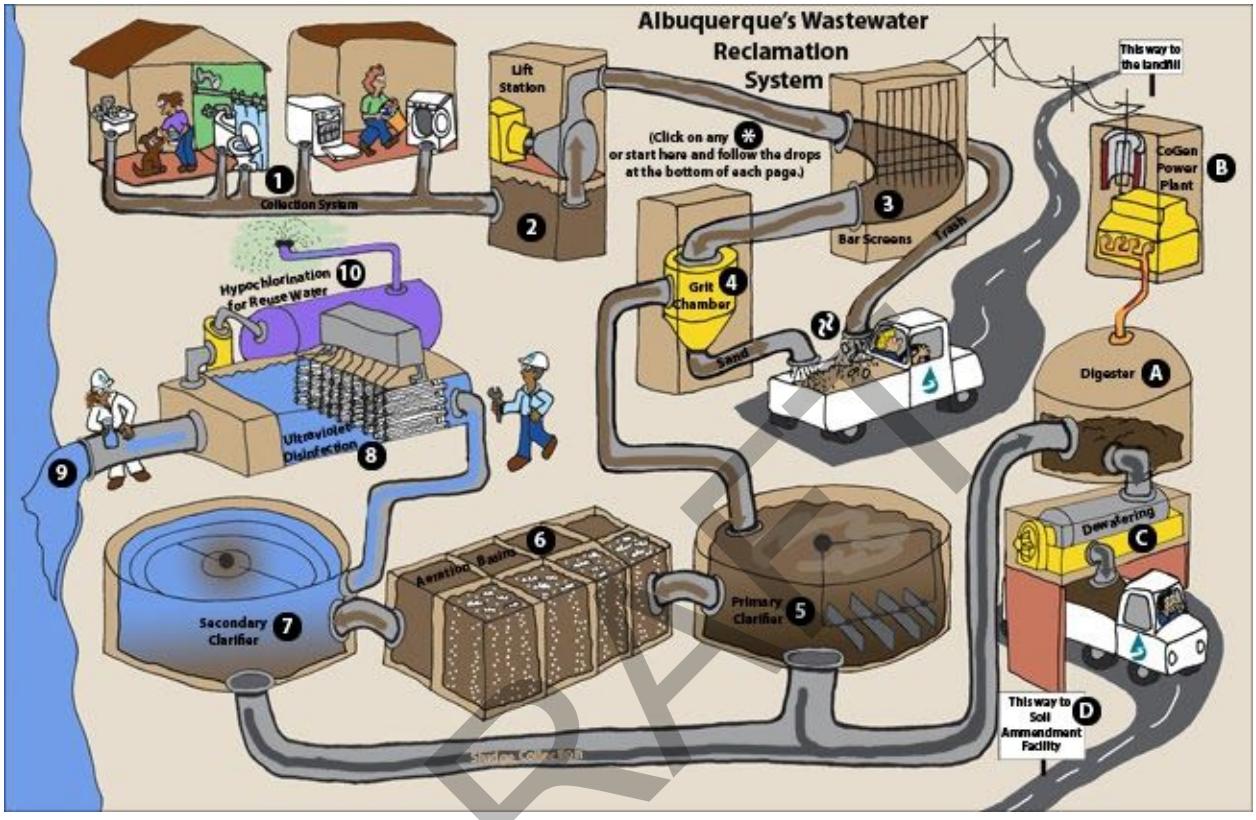
- **Lesson Plan: Cleaning Water**
  http://seplessons.ucsf.edu/node/1754
  - Create a filter in class to clean contaminated water and investigate your findings with the lesson linked below. This activity can be done over the course of a few days in class, or you can demonstrate how a filter works with your class in a shorter lesson.

- **Reflection Questions**
  - Where does your drinking water come from and what communities rely on it?
  - Drinking water is used for much more than bathing, flushing toilets and drinking. What are other ways you and your community use drinking water?
  - Did you learn anything surprising about how we use drinking water, if so what?
  - What percentage of the Earth is covered in water? Out of that amount, how much is accessible fresh water? How much is available as drinking water and why is it important to conserve it?
  - One third of the world's population does not have access to clean drinking water. How would your life be different if you had to walk miles to bring back water to your family?

- **Want to explore further?** Refer to Project 6 in the RiverXchange Curriculum "Drinking Water".
  - You can access the curriculum on your Kidblog homepage or by following this link: https://riverxchange.files.wordpress.com/2018/09/riverxchange-curriculum-20181.pdf

**Water in Our Society:**

# *Wastewater / Groundwater*






**Enhance your student's blog posting and extend their learning beyond the Wastewater presentation with the following activities:**

- **Suggested Reading:**
  - *KOAT* news. 2015. "Aging Pipes Mean Higher Water Bills" http://www.koat.com/news/aging-pipes-could-mean-water-bill-hike/34284754
  - Combined sewer overflows article, by Anne Jefferson, a geology professor from Kent State. http://all-geo.org/highlyallochthonous/2013/03/combined-sewer-overflows-solving-a-19th-century-problem-in-the-21st-century/
- **Activities:**
  - Follow this link to the ABQ Water Utility Authority's website to navigate virtually through Albuquerque's wastewater system: http://www.abcwua.org/Education/SWRP_home.html
    - Want to add a project-based learning component to this exercise? Use these questions and activities to go along with your tour: http://www.abcwua.org/education/educators_WSDcur2_quest.html

- ➢ Show students the *Septic System* poster (the poster can be shown on a smartboard and explain the difference between a **sewer system** and a **septic system** – they both treat wastewater essentially the same way, but a septic tank is right by the house and uses a drainfield in rural areas.

- ➢ Create a Public Service Announcement with your class inspired about what you've learned. Take a video and post it on the blog to share with your partner class!

❖ **Watch:**

- ➢ Watch one of these videos in class to review the process of wastewater and what students can do to take care of wastewater: https://www.youtube.com/watch?v=Ldz29NqwK78 (An animation narrated by a young student)
- ➢ https://www.youtube.com/watch?v=tuYB8nMFxQA (A video of the water treatment process created by New Jersey American Water)
- ➢ Learn about recharging the aquifer in the City of Rio Rancho https://rrnm.gov/4024/Rio-Rancho-Pure

- **Reflection & Discussion:**
  - What is wastewater and how does it impact your community?
  - What is the difference between wastewater, stormwater and drinking water?
  - How can you use what you've learned to make a difference at home and at school?
  - What is the process of treating wastewater in your community? (For RRPS students, generally you are on a septic system). What is the difference between a sewer and septic system?
  - What surprised you about the process of treating wastewater from the presentation?
  - Why is it important to do what we can to keep certain things out of our wastewater, whether it goes to septic system or a wastewater treatment plant?

❖ **Want to explore further?** Refer to Project 8 in the RiverXchange Curriculum "Wastewater".

- ➢ You can access the curriculum on your Kidblog homepage or by following this link: https://riverxchange.files.wordpress.com/2018/09/riverxchange-curriculum-20181.pdf

**Water in Our Society:**

# *Commercial Uses of Our Waterways: Agriculture*

Photo credit: Erich Schlegel

**Enhance your student's blog posting and extend their learning beyond the Agriculture presentation with the following activities:**

- **Suggested Reading:**
  - **Book:** *Out of the Dust* by Karen Hesse (1997: Scholastic Press)
    Written from the poetic perspective of 14 year old Billie Jo as she narrates her family's struggle in Oklahoma during the years of the Depression and the Dust Bowl.
  - **Articles:**
    - *ABQ Journal* article, 2013. "Deal Allows Farmers to Sell Irrigation Water" http://www.abqjournal.com/221194/news/deal-allows-farmers-to-sell-irrigation-water.htm
    - *National Geographic* article, 2014. "Parched: A New Dust Bowl Forms in the Heartland" http://news.nationalgeographic.com/news/2014/05/140516-dust-bowl-drought-oklahoma-panhandle-food/

- **Explore more about the Dust Bowl:** Check out the link below for an informative, interactive website developed by PBS. http://www.pbs.org/kenburns/dustbowl/educators/overview/

- **Lesson Plan: Soil is Not Trivial**
  - Using facts about the Dust Bowl, students write questions and play a trivia activity focused around the establishment of a national soil conservation program and the importance of soil. Students then explore and/or develop a plan to address a local soil conservation issue.
  - http://www.ncagr.gov/SWC/educational/documents/FLP_soil_is_not_trivial.pdf

- **Write a short story**
  - Write a short story from the perspective of someone who is living during, and affected by the Dust Bowl. Explore the PBS website link, or the suggested reading.

- **Lesson plan: Growing Plants**
  - Students will use the story of *The Empty Pot* to explore literature and science, practicing story mapping and learning about the needs of plants and the importance of soil and water. Like the characters in the story, students will plant and observe the growth of seeds. https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=484&author_state=0&grade=3&search_term_lp=growing%20plants

- **Reflection Questions**
  - What was the Dust Bowl and how did it impact people?
  - What do you think are the major agricultural lessons for us from the Dust Bowl?
  - How may we be able to prevent a dust bowl from occurring again?
  - What is important for farmers to consider when planning how to irrigate their farm and why?
  - How does agriculture relate to water and to our daily lives?
  - What did you discover in your planting activity about the different types of irrigation?

- **Want to explore further?** Refer to Project 5 in the RiverXchange Curriculum "Commercial Uses of Our Waterways".
  - You can access the curriculum on your Kidblog homepage or by following this link: https://riverxchange.files.wordpress.com/2018/09/riverxchange-curriculum-20181.pdf

**Water in Our Society:**

# *Commercial Uses of Our Waterways: Acequias*



**Enhance your student's blog posting and extend their learning beyond the Agriculture presentation with the following activities:**

- **Suggested Reading:**
  - **Articles:**
    - *ABQ Journal* article, 2013. "Deal Allows Farmers to Sell Irrigation Water" http://www.abqjournal.com/221194/news/deal-allows-farmers-to-sell-irrigation-water.htm
    - *National Geographic* article, 2014. "Parched: A New Dust Bowl Forms in the Heartland" http://news.nationalgeographic.com/news/2014/05/140516-dust-bowl-drought-oklahoma-panhandle-food/

- **Watch:**
  - *Nuestras Acequias* (20 minutes) and/or *South Valley Acequias* (4 minutes). Discuss the **acequia** system which was put in place by the Pueblo people and early Spanish settlers, how is it organized amongst the community and maintained? What is its cultural and ecological significance?

- Explore the acequia tradition further with *El Agua Es Vida* lessons.

❖ **Lesson Plan: Prior Appropriation**

➢ Using the *Prior Appropriation* activity guide, act out the two different methods of assigning water rights to all the water users. Discuss the difference between the Riparian Rights and Prior Appropriation doctrines. Research the history of water rights in your community and compare the differences in water rights issues with your partners' area. Prior Appropriation is used in the western states, which receive far less precipitation.

❖ **Discuss**

➢ How people have developed technological solutions to solve water problems. For example, many ancient settlements in the West were abandoned because of lack of water, but irrigation technology has made it easier to survive. Dams have made it easier to control the flow of rivers, reservoirs store water, and fish ladders are built so that dams don't prevent their migration. High-efficiency toilets and other appliances help conserve water.

- **Reflection Questions**
  - What did you learn about acequias that you didn't know before this presentation?
  - How are acequias important to life and culture in New Mexico?
  - What would happen to the land if people didn't maintain acequias?
  - What is important for farmers to consider when planning how to irrigate their farm and why?
  - How does agriculture relate to water and to our daily lives?

❖ **Want to explore further?** Refer to Project 5 in the RiverXchange Curriculum "Commercial Uses of Our Waterways".

➢ You can access the curriculum on your Kidblog homepage or by following this link: https://riverxchange.files.wordpress.com/2018/09/riverxchange-curriculum-20181.pdf

**River Ecosystems:**

# *Pole Planting Field Trip*



**Enhance your student's blog posting and extend their learning beyond the Field Trip with the following activities:**

- **Suggested Reading:**
  - **For teacher:** Read or review the 1st part of Chapter 4 of the Bosque Education Guide: A River of Change and discuss with your class the history of the Rio Grande River, the changes made to it's flow and channel, and the impact on the Bosque ecosystem.
- **Make a food web**
  - Make a food web for our local ecosystem, identifying producers, consumers and decomposers, native species and invasive species, as well as local endangered species. Discuss how wildlife are "water users" too. Like humans, wildlife needs clean water to live, so as a community we must consider their needs when making choices about water. Use Bosque plant and animal cards to do *The Web* activity, discussing how all living things depend on each other.
- **Learn about the STRAW Project**
  - An ongoing watershed restoration project first inspired by 4th graders in 1992, based in Marin Co. California! Add it to your school's library and show the documentary in class. http://www.pointblue.org/our-science-and-services/conservation-science/conservation-trai

ning/straw-program or read about the project in this article and discuss how youth can make an impact: http://www.marinij.com/article/NO/20150325/NEWS/150329872

- **Reflection & Discussion:**
  - What did you learn about the history of the Rio Grande River and the floodplain we planted in? How does this history impact the future of cottonwoods in the area?
  - Identify some common invasive species. Where did they come from and how are they impacting the Bosque?
  - What is the process of planting cottonwoods and willows and why do we do it in the wintertime?
  - After this field trip, how may you see and understand the Bosque differently?
  - What did you most enjoy while being down in the Bosque?
  - How can you apply what you learned or enjoyed on your field trip in your everyday life?

❖ **Want to explore further?** Refer to Project 9 in the RiverXchange Curriculum "Field Trip".

➢ You can access the curriculum on your Kidblog homepage or by following the link below: https://riverxchange.files.wordpress.com/2018/09/riverxchange-curriculum-20181.pdf

## Appendix 2
## Photos

Below is a selection of images from our planting field trips:

Thank you for all your hard work and dedication to RiverXchange Melissa McLamb! We will miss you!

Stormwater Quality team outcomes report placeholder

# Bosque Ecosystem Monitoring Program (BEMP)
# Report to the Storm Team of the
# 2019-2020 Stormwater Science Education Program



The main objective of the *Stormwater Science* outreach education program is to teach students how the health of the Rio Grande is directly related to the health of the surrounding watershed and what their responsibility and opportunities are to help keep the "Rio Grand." BEMP educators have developed a Stormwater Science program that includes a 90-minute classroom activity, a four-to-five-hour study trip to the Rio Grande, and optional curriculum extensions incorporating hands-on data analysis, graphing, and system modeling. **During the 2019-2020 school-year and before the schools shut down due to COVID-19, 737 students participated in Stormwater Science** activities in their classrooms, in the field, both, or in outreach events. The classroom program was delivered to **245 students** in **14 classrooms** at **3 different schools** in **Albuquerque.** After the schools shut down, BEMP continued to create new or adapted existing activities related to the Stormwater Science curriculum with the goal of creating equitable educational outreach during the pandemic (see section 10 for outreach numbers and further information).

In addition to the Stormwater Science outreach, BEMP actively involves students in water quality monitoring through the *E. coli* monitoring contract with the Mid Rio Grande Stormwater Quality Team. **11 students from La Academia de Esperanza (LADE)**, **21 University of New Mexico (UNM) undergraduates,** and **3 students from Bosque School** were directly involved in water quality monitoring of the Rio Grande in support of this contract. Students are taught the proper protocols for collecting field parameters and *E. coli* data, but, consistent with our quality assurance plan, are only allowed to collect field parameter data. Typically, students then graph and analyze the data and are supported in presenting their findings at BEMP-supported conferences, professional conferences, and to policy makers; however, this year, these events were canceled due to COVID-19. During this school year, BEMP educators started to create a field journal specific to this water quality monitoring collection to help strengthen student learning and understanding of the data and bigger picture applications.

For the regular school curriculum, the BEMP Stormwater Science program targets middle and high school students using two main formats: an indoor classroom lesson and an outdoor field experience or *Stormwater Study Trip*. This year, during the pre-COVID-19 2019-2020 school year, we continued improving our existing curriculum by making it more NGSS aligned and age appropriate. We also started to incorporate a new assessment tool, Plickers, to assess teaching and lesson content effectiveness. During the pandemic, COVID-19 limited the number of

students we could engage through classroom and field education; however, BEMP continued to support students with a variety of activities through the APS Grab & Go Lunch program in partnership with other STEM organizations across the state to support equitable education, BEMP's social media, and the BEMP's website (See section 10 of this document for more detailed information). BEMP also worked on adapting, when possible, all the spring events to become virtual events (Luquillo-Sevilleta Virtual Symposium and Crawford Symposium; see section 8). BEMP provides handouts for all activities in English and Spanish to better support inclusion and accessibility of STEM resources for New Mexico's diverse communities.

Note: This year, we have structured this report so that in the following sections, we will paraphrase and italicize from previous reports the parts of the curriculum or report that haven't changed and that we continue to adopt. We highlight new work from this contract year in a different, non-italicized paragraph

**1. Classroom curriculum***: Preparation and delivery of Stormwater Science activities in the classroom for middle and high school students* **(245 students)**

The core classroom curriculum and approaches utilizing the watershed model did not change during this school year:

*The principal objective for the middle school classroom curriculum is to demonstrate how some of our daily, individual actions impact the health of the Rio Grande. To reach that goal, students construct a model of the Rio Grande Watershed (See pages 2 & 15 of the curriculum attached as Appendix A & F). The watershed model has five different communities along the river: a cattle ranch, upstream and downstream eco-friendly towns, an urban city, and agricultural fields. Students add different 'runoff cards' to the river downstream of the communities where the runoff constituents originate. Some of the runoff is naturally occurring (e.g. turbidity) while some is human-caused (e.g. pesticides or oil). The model runs through two different scenarios: (1) before-the-storm and (2) after-the-storm. While working through different variations of the model, students record the number of runoff cards introduced into the river before and after a storm event (See handout table; page 2, appendix A). This helps them to conceptualize, quantify, and further discuss the impacts of these changes to the overall river health. Exploring these two scenarios demonstrates the harmful effects that stormwater contamination can have on aquatic organisms and downstream communities.*

*The high school classroom lesson builds upon these core concepts. After discussing the aforementioned watershed model, students learn about some key water quality parameters: temperature, conductivity, dissolved oxygen, turbidity, and dissolved organic matter. Students divide into groups assigned one parameter each. They must then predict how their parameter might be affected by a storm event along with providing justification for their prediction. Students are given graphed data of their parameter before and after actual storm events and must analyze the graphs to determine if the data supports their hypothesis. When classes have more time available, this activity is supplemented by two different curriculum extensions. The first curriculum extension uses the same key water quality parameters introduced in the regular classroom activity, but the students analyze provided data and create their own graphs. We provide (1) a blank graphing sheet with the axis labeled and with the river flow data (used as a reference to talk about the time gap between the increase in cfs and parameter peaking) and (2) a table with measurements for each parameter. This activity helps students learn how to analyze and graph data and then interpret the results, using skills aligned with Next Generation Science*

*Standards (NGSS). The second curriculum extension is a soil porosity and permeability experiment that deepens students' understanding of how different surfaces (natural vs. anthropogenic, permeable vs. impermeable) impact the overall water budget and water quality.*

BEMP updated the middle school classroom curriculum in the 2019-2020 school year to offer the lesson as two separate visits when time allows. The second session involves a graphing activity that includes a stronger action component (page 3, appendix A). The graphing exercise helps students conceptualize the recorded numbers and better understand the impacts of each of the different 'runoff cards' to the overall river health. The action component of the lesson intends to empower students to create change in their daily actions individually but also within their family and community to help keep the "Rio Grand."

This school year, following NGSS guidelines, we added a model/simulation into our high school classroom lesson from a scientific publication (page 4, appendix A) to illustrate the impact of storm surface runoff in the overall water quality of urban versus non-urban areas. This allows us to construct an explanation based on scientific evidence using students' local ecosystem while also hitting a variety of Disciplinary Core Ideas and Performance Expectations within the same NGSS domain (ESS – Earth and Space Science, in this case). This addition also gives high school students the chance to work with recent and local science research.

**2. Stormwater Study Trip:** *Delivery and coordination of place-based Stormwater Science experiences* **(53 students)**

The structure and content of the Stormwater Study Trip did not significantly change from past years:

*The centerpiece of BEMP's stormwater outreach is the Stormwater Study Trip. This activity builds upon classroom activities and facilitates hands-on student experiences including performing water quality testing at the Rio Grande. The Stormwater Study Trip is a four to five-hour trip to the river during which students investigate how stormwater moves through the city and sweeps pollutants and debris into the river. Students also collect and interpret water quality data. The middle school version of the program begins with an explanation of the arroyo system in Albuquerque (See map page 5, appendix B) followed by an arroyo pollution survey where students examine and categorize the amount of visible pollutants (e.g. plastics, paper, dog poop, animal scat, etc.) in Albuquerque's San Antonio arroyo which drains into the bosque. In the arroyo, students test water quality using a LaMotte water quality monitoring kit (page 6, appendix B). When the students hike to the Rio Grande, they do additional water quality testing from two locations. Students then share their results with each other, compare Rio Grande and arroyo water quality data, and discuss what their results could mean in terms of the river's health. This section of the curriculum allows students to have a more hands-on learning experience involving different types of data collection and scientific tools. The high school Stormwater Study Trip uses a similar format with an emphasis on the water quality indices (percent EPT and biotic index) through analyzing collected macroinvertebrates. At the end, the goal for high school students is to connect and understand the two collected data sets and develop a deeper sense of how the system functions on a broader scale.*

In the 2019-2020 school year, BEMP revised the study trips in several ways to strengthen student learning, scientific practices, and stewardship on a local and global scale. This year, BEMP connected the study trips to GLOBE, or Global Learning and Observations to Benefit the Environment. This community science program connects data collection around the world to contribute to our global understanding of the Earth and its processes. BEMP staff redesigned the study trip handout for all grades to better reflect the GLOBE data entry layout in effort to strengthen the stewardship component of the program (pages 5-8, appendix B). BEMP adopted that tool as a way to compare the data collected in our ecosystem to other ecosystems across the globe while also stressing the importance of stewardship from a local to worldwide scale. This tool is being used mainly in our study trip portion of the curriculum.

As part of the high school study trips, BEMP has also began using a multiparameter sonde along with the LaMotte TesTabs that students have used in the past. The multiparameter sonde provides high resolution water quality measurements (temperature, conductivity, specific conductance, pH, turbidity and dissolved oxygen). Using the handout and any additional discussions led by BEMP educators, students learn how to compare results from different methodologies to see how accurate different scientific tools can be. In addition, BEMP staff have also begun to develop a new version of the study trip to work with students during monthly water chemistry monitoring. Part of this work has been spent developing a new handout so this experience has a stronger educational component. This will be further developed in the next school year. Also, the data collected during study trips is now saved in our local drive and can be shared with the Storm Team as requested.

During the 2019-2020 school year, BEMP stopped using the leaf packs for macroinvertebrate identification due to time constraints of the study trips and because of difficulties with the leaf packs themselves. Moving forward, BEMP wants to reassess this methodology in light of challenges we faced last year, as leaf packs ended up buried by sediment or swept away downstream because of the irregular water pulses in the Rio Grande.

BEMP also continued to include Stormwater Science concepts as a part of the after-school program, BEMP After School Science (BASS). A small group of high school students worked with BASS to analyze water samples and collect aquatic macroinvertebrates to gain insight into the overall health of their local ecosystems.

**3. Elementary school outreach:** *Continued delivery and coordination of Stormwater Science experiences for elementary school students* **(300 students)**

BEMP participated again in the Children's Water Festival at the Santa Ana Star Center (300 students and 12 teachers) where BEMP educators, using a new macroinvertebrate activity (See page 9, appendix C), taught fourth grade students about their watershed, how humans impact the health of this system, how aquatic organisms are affected by pollution, and what everyone can do to improve the health of the Middle Rio Grande.

**4. Monthly Monitoring:** *Continued development and delivery of Stormwater Science outreach during Monthly Monitoring*

From last year's report:
*BEMP monthly monitoring is often a space where educational concepts are introduced based upon what students encounter in the bosque or what they are currently studying in class. Because of this, Stormwater Science is only taught intermittently during Monthly Monitoring and has not yet been granularly tracked.*

BEMP continued to include stormwater science topics during the introductory monthly monitoring conversations and whenever appropriate. This helped students see the bigger picture of how the health of the *bosque* is directly tied to the health of the Rio Grande and its watershed.

Furthermore, in addition to the stormwater related conversations, BEMP also adapted an activity that was initially used in the 2018 Children's Water Festival to talk about stormwater related concepts like water pollution and the use of macroinvertebrates as bioindicators of water quality (See page 10, appendix D). The goal of this activity is for students to figure out which one of the four different communities in an imaginary watershed has the best water quality. To reach that goal, students identify the different types of macroinvertebrates that live in each of those communities using a key. The activity ends with a quick group brainstorm about ways to help keep the downstream ecosystems clean (pick up trash and dog poop, fix leaky cars, don't use chemicals, etc.). This activity was piloted during Fall 2019 and can be incorporated as part of the monthly monitoring educational curriculum in the future.

**5. Summer programming:** *Preparation and delivery of Stormwater Science presentations during summer programming* **(200 students + 750 families)**

As in past years, BEMP partnered with Horizons Albuquerque, a tuition-free academic enrichment program that intends to fill the summer learning gap that students from low-income families often encounter. Over six weeks during the summer of 2020, 200 students in grades K-8 learned about how storms impact the overall water quality of our river by working on two of the Stormwater Science activities created during the COVID-19 closure (See page 11 & 14, Appendix E). These activities help connect the students' learning with BEMP and Horizons to the places they live.

This summer, BEMP also partnered with the NM Out-of-School Time Network for their summer Storytime in the Park program where one of the Stormwater Science activities (page 11, appendix E) was given to the 750 families that participated in this year's event.

**6. Stormwater Science curriculum development:** *Continued development of Stormwater Science curriculum*

Part of the 2019-20 school year (before COVID-19 closure) was spent making changes to the Stormwater Science curriculum, continuing to make it more hands-on, engaging, and appropriate for a wider range of students according to NGSS principles. After the closure, BEMP staff shifted to develop curriculum, including Stormwater Science concepts, that would be easily accessible for the communities around New Mexico (see section 10 for more information).

**7. BEMP educational outreach events*:** *Funding covers partial costs for classrooms to participate in Otter Day and BEMP Student Congress*

Because both of these events were scheduled to happen in April 2020, they were cancelled due to COVID-19. However, BEMP expanded the educational and community outreach during the closure through other platforms including the Grab and Go APS meal program, BEMP'S social media, and BEMP's website (see section 10 for more details).

*Funds that covered partial costs for these different BEMP educational outreach events were reallocated for printing and other materials, additional translation efforts to support accessible and equitable education, and staff time in order to continue to support the Stormwater Science program.

**8. Additional BEMP educational outreach and events*:** *Funding covers partial costs for classrooms to participate in Luquillo-Sevilleta Virtual Symposium and Crawford Symposium* **(39 students)**

This year, due to the COVID-19 closure, BEMP continued to organize and deliver the two annual educational events where stormwater science concepts were presented by adopting a fully virtual approach. The Luquillo-Sevilleta Virtual Symposium (LSVS) brings together students involved with the Luquillo Long Term Ecological Research Site in Puerto Rico and students from Albuquerque to share their watershed research with each other via Zoom in Spanish. This year, the LSVS involved 31 students and 19 adults (See page 17, Appendix F). BEMP's Crawford Symposium is an annual conference honoring BEMP's co-founder Dr. Clifford Crawford which celebrates community science along the Middle Rio Grande and showcases environmental research by both students and professionals. The Virtual Crawford Symposium had 8 students and 4 adult presenters, with 60 participants during the live video screening and 210 views after the video was posted on our YouTube channel (page 17, Appendix F).

As part of our outreach, BEMP also participates in other types of activities labeled as "other" in the outreach table (See table page 18, appendix G). These activities included a variety of community educational outreach, ranging from variations of the regular study trip to a student independent research project presented at a water conference with different pueblo representatives in Nambe Pueblo.

**9. Plickers – Assessment tool:** *This tool was used to assess the overall effectiveness of the curriculum in the classroom and study trips*

For the 2019-2020 school year, BEMP started using an assessment tool, Plickers, to monitor the effectiveness of the delivery and content in the Stormwater Science curriculum. Plickers is usually used by teachers to instantly collect multiple-choice responses from students. This tool doesn't require students to have any device; instead, BEMP staff provides printed cards with a unique design (similar to a QR code) to each student and then scans student responses using a phone app (See page 16, Appendix F). Although BEMP cannot publish the results of the assessments in this report due to a lack of IRB approval for research with human subjects, BEMP staff are using assessment results to learn what parts of the stormwater science curriculum are working well or could be improved. Due to time constraints in the classroom and field, BEMP will evaluate the continued use of this tool while also pursuing funding for more formal assessment of student learning.

**10. Outreach during COVID-19 closures:** *Continued delivery of Stormwater Science concepts through the APS Grab & Go Lunch program, BEMP's social media and BEMP's website* **(5811 students)**

Paraphrased and updated from BEMP's report to City of Albuquerque:

Due to the COVID-19 pandemic, Albuquerque Public Schools closed on March 16th, 2020, through the remainder of the 2019-2020 school year. During this time, BEMP continued educational support with 5 of the BASS schools (Van Buren MS, Arroyo del Oso ES, Sombra del Monte ES, Inez ES, and Comanche ES). As many students in New Mexico do not have consistent or reliable access to the Internet, computers, or printers for online distance learning, BEMP created equitable educational outreach through both virtual and physical access.

BEMP delivered weekly, bilingual STEAM activities to each school for distribution in the APS Grab & Go Lunch program. Each school requested at least 150 copies of the activities in English as well as 20-50 copies in Spanish. BEMP staff followed best practices for handling these materials with gloves, washing hands or using hand sanitizer frequently, and packing materials in Ziploc bags. Since early April, BEMP has collaborated with other STEAM organizations, such as NM MESA, Wild Friends and ABCWUA (for full list, see page 16, appendix F) to distribute these activities to even more schools and community locations around Albuquerque and New Mexico as a whole. The BEMP activities focus on getting students and their families to look outside and/or explore their yards and neighborhoods for life around them, while also collecting their own data. Four of those activities had a direct stormwater science focus (pages 11-14, appendix E).

From March 26 to June 30, 2020, approximately 10,100 students received BEMP activities through the five Grab & Go meal locations and free Little Libraries around the city. About 5,800 of those students received an activity with a stormwater science focus. During that time frame, BEMP also worked with Children's Choice coordinators at three of the schools to distribute 270 handouts to participating students, many of which were children of essential workers during the pandemic. For summer 2020's Storytime in the Park program through the NM Out-of-School Time Network, BEMP reached 750 families with a hands-on, place-based SWS activity.

In addition to distribution at the Grab & Go locations, these activities were also posted on BEMP's website (www.bemp.org/education-resources ; See page 16, appendix F) using a GitHub database to keep track of engagement through the number of downloads and views. These numbers can be provided directly to the Storm Team upon request.

BEMP has also increased presence on social media, such as Facebook and Instagram, to reach more of the community. The weekly Grab & Go activities were shared on social media to engage people who might not get them from the schools. Every day of the week, BEMP staff highlighted BEMP activities, ecological information, and resources from partners. SWS related concepts were presented usually once a week in our Water Wednesday posts (Page 17, appendix F). These posts included topics like (1) water pollution and its effect on wildlife, along with how to help; (2) local water use/consumption; (3) good practices to reduce impacts on water quality; (4) FOG waste disposal; (5) options to reduce water usage, and more. Besides Water Wednesday, the

weeks that the Grab & Go activities were about stormwater concepts, BEMP also dedicated the full week in social media to talk about water-related topics. BEMP provided English and Spanish versions of all the activities and social media posts previously mentioned.

Table 1: Social media interactions from March 16 – June 30, 2020

| | INSTAGRAM | FACEBOOK |
|---|---|---|
| REACHES | 3344 | 5007 |
| ENGAGEMENTS | 539 | 509 |

Note: BEMP used Creator Studio to track Facebook and Instagram engagement through a variety of different metrics. "Reaches" refers to how many people saw either a specific post or any content from the social media pages. Then, "engagements" refers to the total number of likes, shares, clicks, and people clicking "see more" for longer posts.

# APPENDICES

*Only updated versions of the curriculum material since last year's report

## APPENDIX A: CLASSROOM HANDOUTS

### Classroom Handout – Middle School – Graphing – DAY 1

BEMP
Bosque Ecosystem Monitoring Program
www.bemp.org 2018

Hydrologist: _____ Date: _____

**Stormwater Science**

What 2 sources can New Mexicans get their drinking water from?

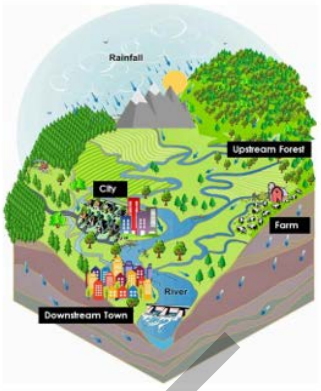
1. _____

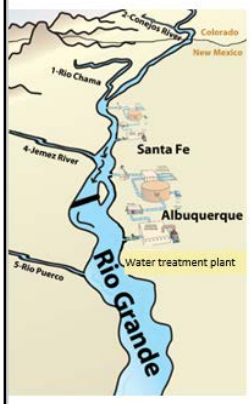
2. _____

Where does water go after we use it?

_____

A ***watershed*** is an area of land where all of the water that falls on it, or that is under it, drains to the lowest point.




**Draw a line from the word to its definition**

| | |
|---|---|
| Turbidity | ♦ A stream or arroyo that brings water to the main channel of the river |
| Nonpoint source pollution | ♦ Types of nutrients found in fertilizers that can lead to excess algae growth |
| *E.coli* | ♦ A single location where pollution is being leaked into the environment |
| Point source pollution | ♦ A type of *bacteria* found in warm blooded animal's intestines that can make people sick |
| Nitrates and phosphates | ♦ Tiny 'water bugs' whose species are an indication of water quality |
| Tributary | ♦ *Any* type of pollution that comes from *many different* sources |
| Macro-invertebrates | ♦ A measure of water clarity based on the amount of suspended solids |

**Is the river healthier before or after a storm event?**

Before: Amount | After: Amount + ↑ / ↓ / = ✓ ✗

| | Up-stream ecofriendly town | | Cattle ranch | | Agricultural field | | Urban city | | Down-stream ecofriendly town | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After | Before | After | Before | After |
| Oxygen | 3 | | 3 | | 3 | | 3 | | 3 | |
| Nutrients (Nitrates and phosphates) | 0 | | 1 | | 1 | | 1 | | 0 | |
| Turbidity | 1 | | 1 | | 1 | | 1 | | 1 | |
| Macroinvertebrates (healthy – unhealthy) | 2 0 | | 2 0 | | 2 0 | | 1 1 | | 1 1 | |
| Fish biodiversity (green – red – blue – yellow) | 1 1 1 1 | | 1 1 1 1 | | 1 1 1 1 | | 1 1 1 1 | | 1 1 1 1 | |
| Pesticides, Herbicides and Fungicides | 0 0 0 | | 0 0 0 | | 1 0 0 | | 1 0 0 | | 0 0 0 | |
| Trash | 0 | | 0 | | 0 | | 1 | | 0 | |
| Oil and gasoline | 0 | | 0 | | 0 | | 1 | | 0 | |
| Chemicals and medicine | 0 0 | | 0 0 | | 0 0 | | 1 3 | | 0 0 | |
| *Escherichia coli* | 1 | | 1 | | 1 | | 1 | | 1 | |

**Water quality AFTER a storm event:** 👍 👎

*Which community has the most polluted water AFTER a storm event?* _____

How can YOU help to keep the watershed clean?

1._____

2._____

3._____

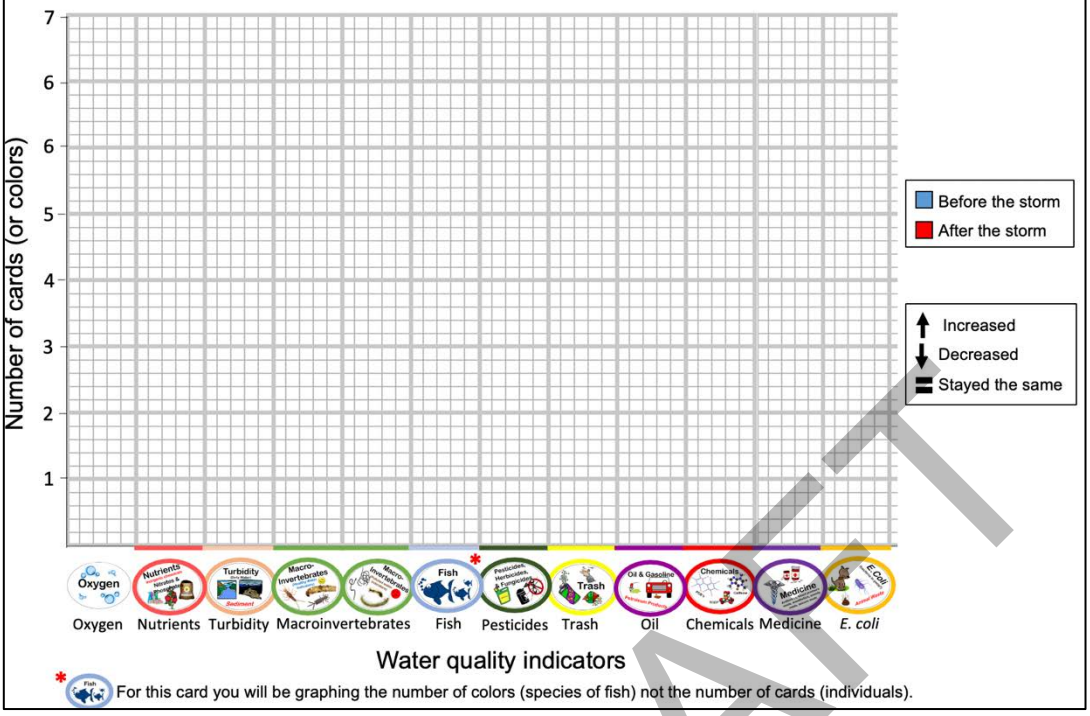
4._____

**Classroom Handout – Middle School – Graphing – DAY 2**

BEMP
Bosque Ecosystem Monitoring Program

Hydrologist: _____ Date: _____

Community: _____




BEMP
Bosque Ecosystem Monitoring Program

Hydrologist: _____ Date: _____

**Graph results & discussion:**

**Your community _____:**

- ↑ _____
- ↓ _____
- = _____
- _____
- _____

**Overall watershed:**

1. Which community has the most polluted water AFTER a storm event (over time)?

_____

Why? _____

_____

**Big picture:**

How can I help improve the health of the Rio Grande?

**As an individual…**

1. _____
2. _____
3. _____
4. _____
5. _____

**As part of the community…**

1. Environmental Mitigation:_____
2. Bioremediation:_____
3. Fight for ***environmental justice***:_____
4. _____
5. _____

## Classroom Handout – High School

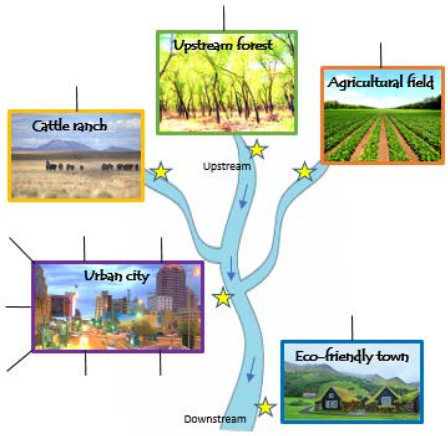
BEMP Bosque Ecosystem Monitoring Program

Name: _____ Date: _____

# Stormwater Science

What is a **watershed**?

### 1. River composition during a storm event: A hypothetical watershed example
**(Natural and anthropogenic inputs)**




*Which community has the most polluted water AFTER a storm event?* _____ *Why?* _____

### 2. Data Analysis: A real example of a storm event in a city

Parameters analyzed:
- Temperature:
- Conductivity:
- Dissolved Oxygen (DO):
- Turbidity:
- Dissolved Organic Matter (DOM):

*Example*

**Parameter:** Conductivity

**Prediction:** *Water conductivity will drop right after an storm event due to the new input of rain water with no salts.*

**Justification:**

Your data

**Parameter:**

**Group prediction:**

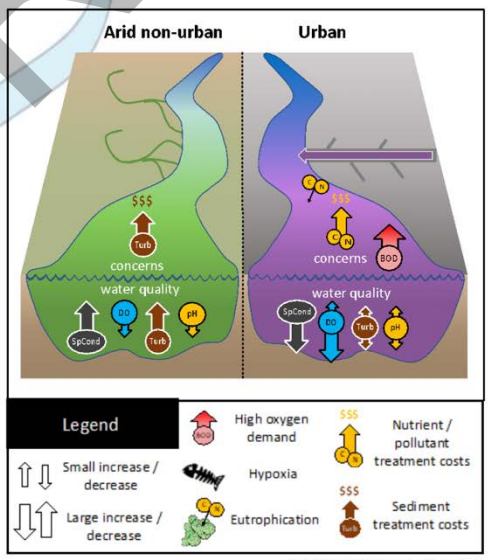
**Justification:**

- Was your prediction supported based on your data analysis? Explain why or why not.

### Data Analysis: General discussion

1. In which order did the parameters react to the storm event?
1. In which season did this storm event occur?
1. Do you think these storm event peaks would be higher or lower in a different season? Why?
1. Would you expect the same parameter behavior in a non-urban area? Why?
1. Does the overall water quality after a storm event increase or decrease?

### Take-home conceptual figure




Adapted from Regier et al. 2020

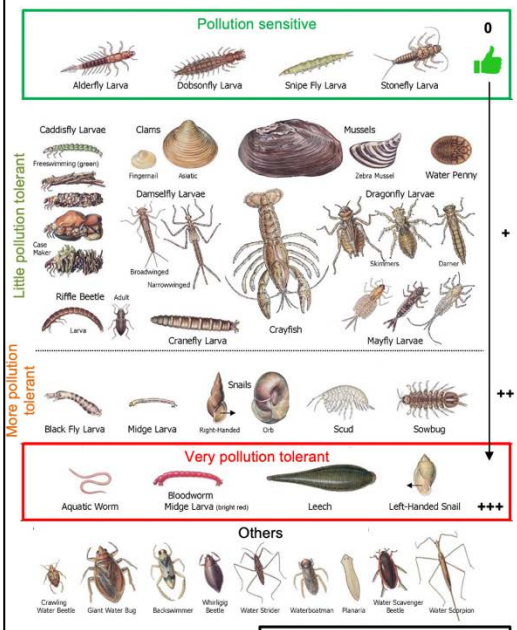
### 3. How can YOU help improve the health of the river after a storm event?

1._____
2._____
3._____
4._____

## APPENDIX B: STUDY TRIP HANDOUTS

### Field Journal for study trips – Middle School

**Macroinvertebrates as long term pollution bioindicators**




Pollution sensitive _____
Little pollution tolerant _____
More pollution tolerant _____
Very pollution tolerant _____

**Water quality level:**

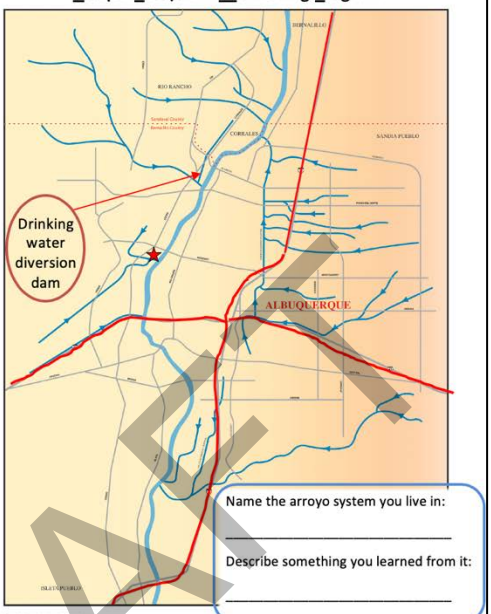
8

Name:_____ Date:_____

# Stormwater Science

## Field Journal

Bosque Ecosystem Monitoring Program




Name the arroyo system you live in:

_____

Describe something you learned from it:

_____

BEMP THE GLOBE PROGRAM STORMWATER QUALITY TEAM



### Litter Survey

The San Antonio Arroyo collects runoff from all over the west side of Albuquerque. Tally the litter you find throughout the day here. Is it a point source pollution or a non-point source pollution?

| Litter type | Arroyo or Backwater pond | River |
|---|---|---|
| Plastic | | |
| Paper | | |
| Glass | | |
| Metal | | |
| Dog poop<br>Animal scat | | |
| Other trash | | |

### How long will it take?

Test your knowledge about decomposition times below by drawing a line from the item to its decomposition time.

| | |
|---|---|
| Banana peel | 1–2 million years |
| Cigarette butt | 600 years |
| Fishing line | 450 years |
| Styrofoam cup | 20–1000 years |
| Milk carton | 200–500 years |
| Plastic bottle | +1 million years |
| Aluminum can | 1.5–10 years |
| Glass bottle | 5 years |
| Plastic bag | 3–4 weeks |

2

### Overall reflection

1. Are the water chemistry results for the arroyo different form the river? Why?
2. How does the weather effect the river based on today's water chemistry results?
3. Are the macroinvertebrate indices different between the pond and the river? Why?
4. Why is important to compare the water chemistry of the river to the macroinvertebrate data?
5. Do these two measurements show the same overall results?
6. If the overall river health is fair or poor, who do you think is responsible? Is the river health scenario caused by a point source or a non-point source pollution?
7. Assess and design solutions to reduce the effect of some of this human impacts mentioned today (urban development or water pollution):

7

**Field Journal for outdoor study trips (cont.) - MS**

## 2.1 Water quality index:

**A) Percent EPT**

It's short for the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Many species within these three groups are sensitive to changes in water quality.

***In general, the more EPT taxa, the better the water quality.***

*Calculate Percent EPT*

*Step 1*

Add the total number of mayflies, stoneflies, and *other* caddisflies. Attention!: Hydropsychidae don't count towards percent EPT!

Pond: _____ River: _____

*Step 2*

Divide the number of EPT individuals by the total number of individuals in the sample(s).

Pond: _____ River: _____

*Step 3*

Convert to percentage.

Pond: _____ River: _____

Based on your EPT values draw conclusions about the quality of the water:

Pond: _____

River: _____

6

## 1. Water Chemistry

Site Name: _____ Time: _____

Water State:

☐ Normal ☐ Frozen ☐ Dry ☐ Flooded ☐ Unreachable

| | Arroyo or Backwater pond | River |
|---|---|---|
| Temperature | Test 1: °C<br>Test 2: °C<br>Test 3: °C | Test 1: °C<br>Test 2: °C<br>Test 3: °C |
| Conductivity | Test 1: µS/cm<br>Test 2: µS/cm<br>Test 3: µS/cm | Test 1: µS/cm<br>Test 2: µS/cm<br>Test 3: µS/cm |
| pH | Test 1:<br>Test 2:<br>Test 3: | Test 1:<br>Test 2:<br>Test 3: |
| Dissolved Oxygen | Test 1: mg/L<br>Test 2: mg/L<br>Test 3: mg/L | Test 1: mg/L<br>Test 2: mg/L<br>Test 3: mg/L |
| Nitrates | ppm | ppm |
| Phosphates | ppm | ppm |
| Turbidity | NTU | NTU |
| E. coli | Present / Absent | Present / Absent |

Overall river health: (circle one)

Good Fair Poor

3

**Temperature**
8-12 °C- good
13-15 °C- fair
>15 °C- poor

**Conductivity**
~100 – 1000 µS
*Urban or non-urban
*Before or after storm

**pH**
1-strong acid- poor
6-weak acid- fair
7-neutral- good
8-weak base-fair
14-strong base-poor

**Dissolved Oxygen**
1 ppm or 60-100% -good
4 ppm or 40-60%- fair
8 ppm or 0-40%- poor

**Nitrates**
Sources: plants, soil, fertilizer
1-4 ppm- good
5- 20 ppm- fair
>20 ppm- poor

**Phosphates**
Sources: plants, fertilizer, plastic
1 ppm- good
2 ppm- fair
4ppm- poor

**Turbidity**
Sources: erosion, fire
1-39 JTU- good
4--100 JTU- fair
>100 JTU- poor

**E. coli**
Sources: animal waste
E.coli will always be present in small amounts. Large amounts are harmful to humans and animals

### Weather Report – Atmosphere

1. Today's Weather:

2. Cloud Identification:

*High (in the sky):*
(Check all types seen)


❑ Cirrus


❑ Cirrocumulus


❑ Cirrostratus

*Middle (of the sky):*
(Check all types seen)


❑ Altostratus


❑ Altocumulus

*Low (in the sky):*
(Check all types seen)


❑ Stratus


❑ Stratocumulus


❑ Cumulus

*Rain or Snow Producing Clouds:*
(Check all types seen)


❑ Nimbostratus


❑ Cumulonimbus

3. Temp: It feels like: _____°F It actually is.... _____°F

4

## 2. Water biology: Macroinvertebrates

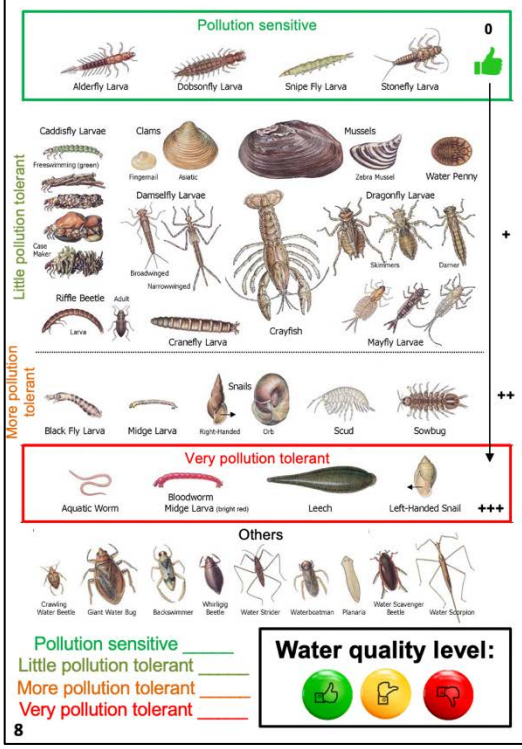
Select your favorite macroinvertebrate in your sample and draw it in the box below . Make sure to include any key features. Add at the bottom the scientific name using the identification guides. After, make sure to fill out the table below with all the organisms you found.

| Phyllum, Class or Order | Family, Genus or Species | Common name | Total count |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

5

**Field Journal for study trips – High School**

## Macroinvertebrates as long term pollution bioindicators




Pollution sensitive _____
Little pollution tolerant _____
More pollution tolerant _____
Very pollution tolerant _____

**Water quality level:**

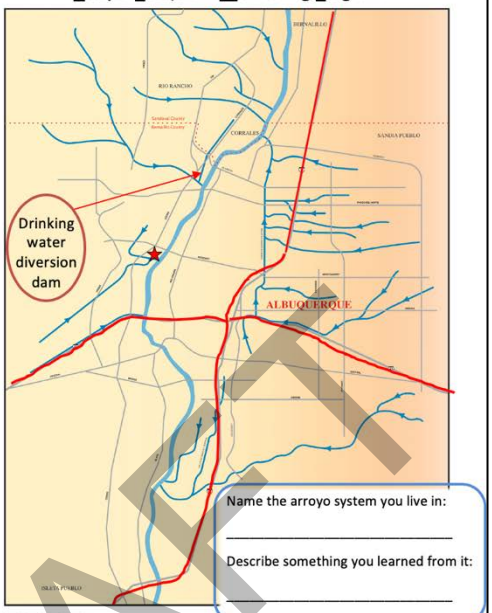
8

Name:_____ Date:_____

# Stormwater Science

## Field Journal

Bosque Ecosystem Monitoring Program




Name the arroyo system you live in:

_____

Describe something you learned from it:

_____

BEMP THE GLOBE PROGRAM STORMWATER QUALITY TEAM

## 1. Water Chemistry: Sonde / LaMotte kit

Site Name:_____ Time:_____

Water State:

☐ Normal ☐ Frozen ☐ Dry ☐ Flooded ☐ Unreachable

| Sonde or LaMotte kit | Arroyo or Backwater pond | River |
|---|---|---|
| Temperature | Test 1: °C<br>Test 2: °C<br>Test 3: °C | Test 1: °C<br>Test 2: °C<br>Test 3: °C |
| Conductivity | Test 1: µS/cm<br>Test 2: µS/cm<br>Test 3: µS/cm | Test 1: µS/cm<br>Test 2: µS/cm<br>Test 3: µS/cm |
| pH | Test 1:<br>Test 2:<br>Test 3: | Test 1:<br>Test 2:<br>Test 3: |
| Dissolved Oxygen | Test 1: mg/L<br>Test 2: mg/L<br>Test 3: mg/L | Test 1: mg/L<br>Test 2: mg/L<br>Test 3: mg/L |
| Turbidity | NTU | NTU |
| Nitrates | ppm | ppm |
| Phosphates | ppm | ppm |
| E. coli | Present / Absent | Present / Absent |

Overall river health: (circle one)

Good Fair Poor

2

| Biotic Index | Water Quality | Degree of Organic Pollution |
|---|---|---|
| <3.75 | Excellent | Organic pollution unlikely |
| 3.75-5.0 | Good | Some organic pollution |
| 5.1-6.5 | Fair | Substantial pollution likely |
| 6.6-10.0 | Poor | Severe pollution likely |

## Overall Conclusions

1. Why is important to compare the water chemistry of the river to the macroinvertebrate data?
2. Do these two measurements show the same overall results?
3. Are the water chemistry results for the arroyo different form the river? Why?
4. Are the macroinvertebrate indices different between the pond and the river? Why?

7

# Field Journal for outdoor study trips (cont.) - HS

**B) Biotic Index**

Biotic Index is a comparison of the abundance of taxa and their tolerance to environmental stress. This widely used index can indicate organic and nutrient pollution. Organisms are assigned tolerance values which range from 0 to 10, depending on the organism's sensitivity to changes in water quality and habitat (tolerance values increase as water quality decreases).

**In contrast to the percent EPT index, the lower the biotic index, the better the water quality.**

*Calculate Biotic Index*

*Step 1*
To calculate the Total Tolerance Value (D), multiply each taxa (B) by the Pollution Tolerance Value (C) and record in column D.

*Step 2*
Add all Total Tolerance Value values (D): _____

*Step 3*
Add all Average # from all packs (B): _____
This is the *total number of individuals*.

*Step 4*
Divide all Total Tolerance Value (step 2) by total number of Individuals (step 3).

_____

*Step 5*
Look up the Biotic Index Value in the table to know the degree of organic pollution:

6 _____

| Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|
| 8-12 °C- good<br>13-15 °C- fair<br>>15 °C- poor | ~100 – 1000 µS<br>*Urban or non-urban<br>*Before or after storm | 1-strong acid- poor<br>6-weak acid- fair<br>7-neutral- good<br>8-weak base-fair<br>14-strong base-poor | 1 ppm or 60-100% -good<br>4 ppm or 40-60%- fair<br>8 ppm or 0-40%- poor |

| Nitrates | Phosphates | Turbidity | E. coli |
|---|---|---|---|
| Sources: plants, soil, fertilizer<br>1-4 ppm- good<br>5- 20 ppm- fair<br>>20 ppm- poor | Sources: plants, fertilizer, plastic<br>1 ppm- good<br>2 ppm- fair<br>4ppm- poor | Sources: erosion, fire<br>1-39 JTU- good<br>4--100 JTU- fair<br>>100 JTU- poor | Sources: animal waste<br>E.coli will always be present in small amounts. Large amounts are harmful to humans and animals |

## Weather Report

1. Today's Weather:

2. Wind: Speed: _____mph Direction:


3. Temp: It feels like: _____°F It actually is.... _____°F

## Reflection/Conclusions

1. How does the weather effect the river based on today's water chemistry results?

2. If the overall river health is fair or poor, who do you think is responsible? Is the river health scenario caused by point source or non-point source pollution?

3

## 2. Water biology: Macroinvertebrates (Pond or River)

| Taxon | A Total # in your pack | B Average # from all packs | C Pollution Tolerance Value | D Total Tolerance Value |
|---|---|---|---|---|
| EPHEMEROPTERA (Mayflies) | | | 3.6 | |
| PLECOPTERA (Stoneflies) | | | 1 | |
| TRICHOPTERA (Caddisflies) | | | | |
| Hydropsychidae (Common Netspinners) | | | 5 | |
| Other caddisflies | | | 2.8 | |
| ANISOPTERA (Dragonflies) | | | 4 | |
| ZYGOPTERA (Damselflies) | | | 7 | |
| MEGALOPTERA | | | | |
| Corydalidae (Hellgrammites) | | | 3 | |
| Sialidae (Alderflies) | | | 4 | |
| COLEOPTERA (Beetles) | | | 4.6 | |
| DIPTERA (True Flies) | | | | |
| Athericidae (Watersnipe flies) | | | 2 | |
| Chironomidae (Midges) | | | 6 | |
| Simuliidae (Black flies) | | | 6 | |
| Tipulidae (Crane flies) | | | 3 | |
| Other Diptera | | | 6 | |
| AMPHIPODA (Scud) | | | 6 | |
| ISOPODA (Aquatic sowbugs) | | | 8 | |
| DECAPODA (Crayfish) | | | 5 | |
| OLIGOCHAETA (Aquatic Worms) | | | 8 | |
| HIRUDINEA (Leeches) | | | 8 | |
| TURBELLARIA (Planarians) | | | 8 | |
| GASTROPODA (Snails) | | | 7 | |
| SPHAERIIDAE (Fingernail clams) | | | 8 | |

4

## 2.1 Water quality indices:

**A) Percent EPT**

It's short for the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Many species within these three groups are sensitive to changes in water quality.

***In general, the more EPT taxa, the better the water quality.***

*Calculate Percent EPT*

*Step 1*
Add the total number of mayflies, stoneflies, and *other* caddisflies.
Attention!: Hydropsychidae don't count towards percent EPT!

**Pond:** **River:**

*Step 2*
Divide the number of EPT individuals by the total number of individuals in the sample(s).

**Pond:** **River:**

*Step 3*
Convert to percentage.

**Pond:** **River:**

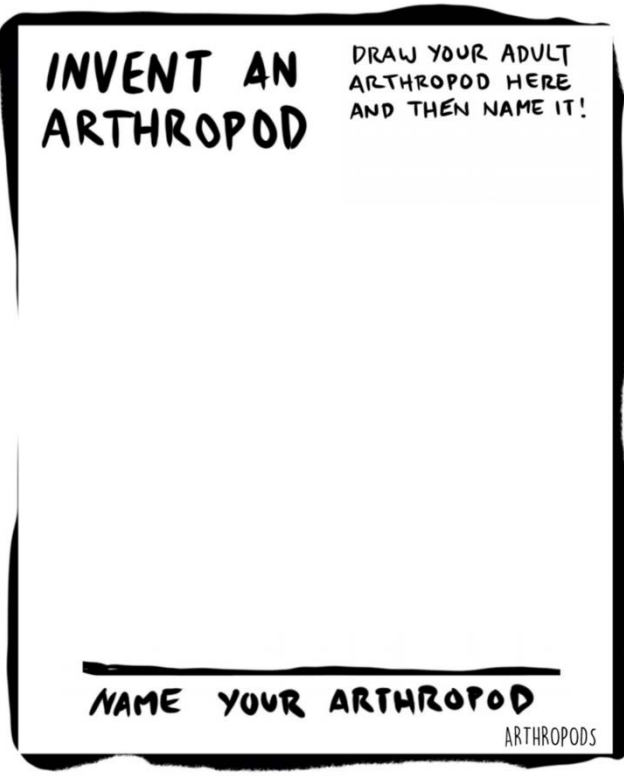
Based on your EPT values draw conclusions about the quality of the water:

**Pond:**

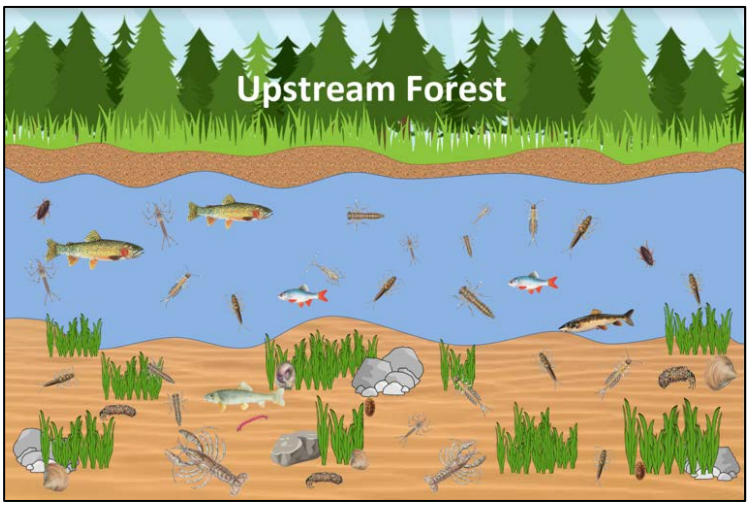
**River:**

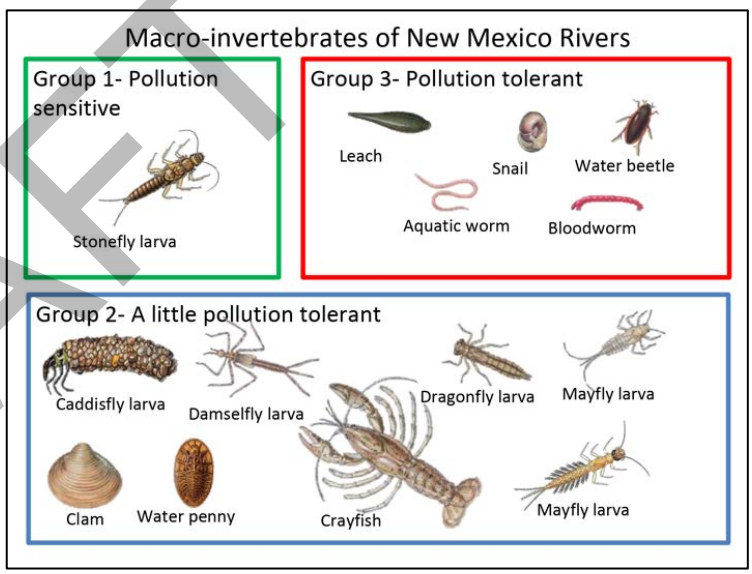
5

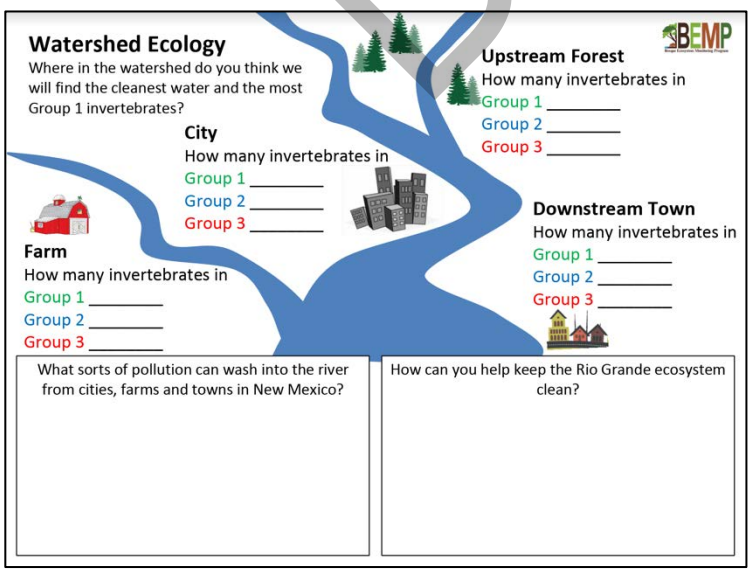
## APPENDIX C: ELEMENTARY SCHOOL OUTREACH

## APPENDIX D: MONTHLY MONITORING ACTIVITY



# APPENDIX E: GRAB & GO MEAL PROGRAM ACTIVITIES

**River otters and other animals that live near the river are affected by pollution in the water.** Check out this activity to learn more about how the pollution gets there in the first place!


## Stormwater and Pollution (for all ages!)

**Stormwater** is water from rain or snow that flows over the ground or other surfaces until it reaches the lowest point of an area. In cities or towns, the water can't soak into the ground like it would in a forest and other ecosystems. Instead, it slides over sidewalks and roads until it flows into gutters, ditches, streams, and rivers like the Rio Grande. *What do you think this water picks up during its journey to the river?*

**The Raindrop Journey:** Have you ever wondered where water goes after it rains? Which kind of obstacles might a water droplet find along the way? Are these obstacles natural or human made?

*Step outside and imagine the possible path of a water droplet from your home to the river. Write a short story about it or draw a map of its journey.* Don't forget to think about everything it might run into or take with it along the way!

*Share your story with a friend or family member. After, discuss ways in which YOU can help reduce the obstacles this water droplet finds along the way. How are these obstacles affecting the animals and plants living in the water?*

**Take it to the next level!**

Water pollution is a big problem that affects the health of humans, plants, and animals living in an ecosystem. To learn more about this topic, walk around your neighborhood or go to your favorite park/trail with your family and count the litter you find along the way. How did this litter get here? Why is this type of pollution a problem? Learn more by reading about **point source** and **nonpoint source pollution**. Record what you find on this table. If you want to go further, you can even make a bar graph of the amounts you find-- Get creative! If you have gloves and a trash bag, don't forget to pick up the trash you found after you count it!

| **Litter type** | Where? _____ | Why is this type of pollution a problem? |
|---|---|---|
| Plastic | | |
| Paper | | |
| Glass | | |
| Metal | | |
| Dog poop | | |
| Oil/gasoline | | |
| Other trash | | |

Find out more about the Bosque Ecosystem Monitoring Program at www.bemp.org! Tell us what you thought about this activity at https://tinyurl.com/bemp-survey

**Las nutrias de río y otros animales que viven cerca del río se ven afectados por la contaminación del agua.**¡Echa un vistazo a esta actividad para aprender más sobre cómo la contaminación llega hasta el río en primer lugar!


## Agua pluvial y contaminación (¡para todas las edades!)

El **agua pluvial**es agua procedente de la lluvia o la nieve que fluye sobre el suelo u otras superficies hasta que alcanza el punto más bajo de una área. En ciudades o pueblos, el agua no puede penetrar en el suelo como lo haría en un bosque u otros ecosistemas. En cambio, esta agua se desliza sobre las aceras y carreteras hasta que desemboca en canales, zanjas, arroyos y ríos como el Río Grande. *¿Qué crees que esta agua recoge durante su viaje hacia el río?*

**El viaje de una gota de agua:**¿Alguna vez te has preguntado a dónde va el agua cuando termina de llover? ¿Qué tipo de obstáculos podría encontrar una gota de agua durante su viaje? ¿Son estos obstáculos naturales o creados por el hombre?

*Sal afuera e imagina el posible camino de una gota de agua desde tu casa hasta el río. Escribe una historia corta al respecto o dibuja un mapa de su viaje.*¡No te olvides de pensar en todo lo que puede encontrar o llevarse en el camino!

*Comparte tu historia con un amigo o familiar. Después, discute diferentes formas en que TÚ puede ayudar a reducir los obstáculos que esta gota de agua encuentra en su camino. ¿Cómo afectan estos obstáculos a los animales y plantas que viven en el agua?*

**¡Pasa al siguiente nivel!**

La contaminación del agua es un gran problema que afecta la salud de los humanos, las plantas y los animales que viven en un ecosistema. Para obtener más información sobre este tema, camina por tu vecindario o vete a tu parque/sendero favorito con tu familia y cuenta la basura que encuentres en el camino. ¿Cómo llegó esta basura aquí? ¿Por qué es este tipo de contaminación un problema? Obtén más información al leer sobre la **contaminación puntual** y **difusa**. Documenta lo que encuentres en esta tabla. Si deseas ir más allá, incluso puedes hacer una gráfica de barras de las cantidades que encuentres. ¡Sé creativo! Si tienes guantes y una bolsa de basura, ¡no te olvides de recoger la basura que encontraste después de contarla!

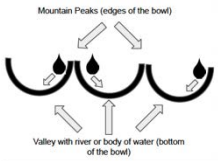
| **Tipo de basura** | Dónde? _____ | ¿Por qué es este tipo de contaminación un problema? |
|---|---|---|
| Plástico | | |
| Papel | | |
| Vidrio | | |
| Metal | | |
| Heces de perro | | |
| Aceite/ gasolina | | |
| Otra basura | | |

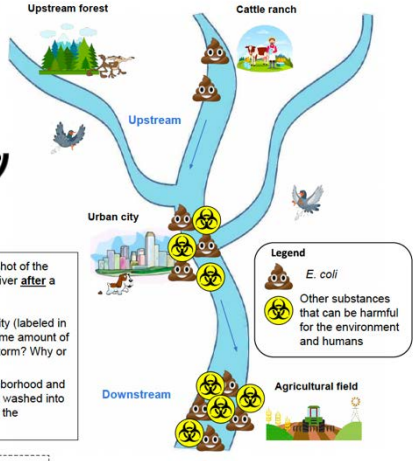
¡Para saber más sobre el *Bosque Ecosystem Monitoring Program* visita www.bemp.org! Cuéntanos qué te pareció esta actividad en https://tinyurl.com/bemp-espanol

## What the poop!? (for all ages!)

***E. coli*** is a common bacteria found in poop of warm-blooded animals, like dogs and humans. If you eat or drink something with this bacteria in it, it can make you sick. Do you think there is a lot of *E. coli* in the Rio Grande? How did it get there? Learn more about *E. coli* and other pollutants in water through this activity!

*We all live in a **watershed,** or an area of land where water that falls on it drains to the lowest point. Watersheds are almost like a bowl, where water slides down the edges to the bottom:*




The watershed on the right is a snapshot of the pollutants that can be washed into a river **after** a storm happens.

1. Do you think that each community (labeled in black, bold text) releases the same amount of pollutants into the river after a storm? Why or why not?
2. Go for a walk around your neighborhood and try to find pollutants that can get washed into the river after a storm. What are the pollutants?

**Take it to the next level:**

This table has the amount of *E. coli* and other substances **BEFORE** a storm. Complete the table by counting how many emojis (*E. coli* and other pollutants) are in each of the communities **AFTER** a storm. Create a bar graph of the results for before and after a storm. Which community has the most polluted water after a storm? Why?

| | Cattle ranch | | Urban city | | Agricultural field | |
|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After |
| *E. coli* | 1 | | 2 | | 1 | |
| Other | 0 | | 1 | | 1 | |

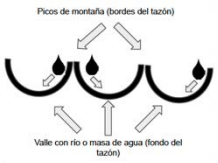
Every community, including Albuquerque, is downstream of someone, and other communities are downstream of us! Research how contaminants like *E.coli*, pesticides, fertilizers, and oil impact animals and humans. What is one thing you can do to help decrease the amount of these substances in the river? Remember, there is no (dog) poop fairy!

Find out more about the Bosque Ecosystem Monitoring Program at www.bemp.org! Tell us what you thought about this activity at https://tinyurl.com/bemp-survey

## ¡Qué caca!? (para todas las edades!)

***E. coli*** es una bacteria común encontrada en caca de animales de sangre caliente, tal como perros y humanos. Si comes o tomas algo con ésta bacteria, puedes enfermarte. ¿Piensas que hay mucha E. coli en el Río Grande? ¿Cómo llego ahí? ¡Aprende más acerca de E. coli y otros contaminantes en el agua a través de ésta actividad!

*Todos vivimos en una **cuenca de agua**, o en un área de tierra donde el agua que cae sobre ella drena hasta el punto más bajo. Cuencas de agua son como una tazón, donde el agua se desliza por los bordes hasta el fondo:*





La cuenca de agua de la derecha es una representación de los contaminantes que pueden ser arrastrados en un río **después** de que sucede una tormenta.

1. ¿Piensas que cada comunidad (etiquetada en texto en negrita) descarga la misma cantidad de contaminantes dentro del río después de una tormenta? ¿Por qué, ó por qué no?
2. Da un paseo alrededor de tu vecindario y trata de encontrar contaminantes que pueden ser arrastrados al río después de una tormenta. ¿Cuáles son los contaminantes?

**Llévalo al siguiente nivel:**

Esta tabla tiene la cantidad de E. coli y otras substancias **ANTES** de una tormenta. Completa la tabla contando cuántos emojis (*E. coli* y otros contaminantes) están en cada una de las comunidades **DESPUÉS** de una tormenta. Crea una gráfica de barra con los resultados de antes y después de una tormenta. ¿Cuál comunidad tiene el agua más contaminada después de una tormenta? ¿Por qué?

| | Cattle ranch | | Ciudad urbana | | Terreno agrícola | |
|---|---|---|---|---|---|---|
| | Antes | Después | Antes | Después | Antes | Después |
| *E. coli* | 1 | | 2 | | 1 | |
| Otros | 0 | | 1 | | 1 | |

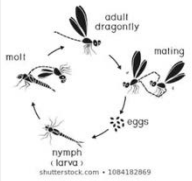
¡Cada comunidad, incluida Albuquerque, es transformadora de alguien, y otras comunidades son transformadoras de nosotros! Investiga de qué manera los contaminantes tales como E. coli, pesticidas, fertilizantes y aceite impactan a los animales y a los humanos. ¿Qué cosa puedes hacer para ayudar a disminuir la cantidad de éstas substancias en el río? ¡Recuerda, no hay hada para caca de perro!

Encuentra más sobre el Programa de Monitoreo de Ecosistemas de Bosque en: www.bemp.org!
Cuéntanos qué te pareció esta actividad en: https://tinyurl.com/bemp-espanol

## Aquatic Macroinvertebrates (for all ages!)

Besides arthropods (bugs) on land, there are many arthropods that live in water! These are called **aquatic invertebrates**. Aquatic invertebrates have exciting life cycles and can give us information on how healthy water is. These activities will focus on aquatic invertebrates that you can see without a microscope, called **macroinvertebrates!** Have you seen an aquatic macroinvertebrate before? Crayfish are very common aquatic macroinvertebrates!

Many macroinvertebrates undergo **metamorphosis,** or physical changes as they become adults. Animals like frogs and butterflies go through metamorphosis. Take a look at this graphic to see how some macroinvertebrates undergo metamorphosis:




Before a macroinvertebrate morphs into an adult, it is called a **larva**. Sometimes, larvae and adults of the same species look very different. After taking a look at this macroinvertebrate larva below, draw what you think the adult version of it will look like!

- What does your adult eat?
- Where does it live?
- What is its name?

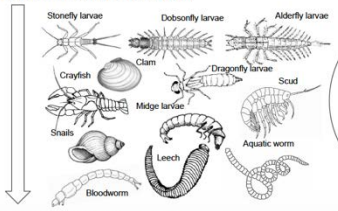
*The adult should have special body parts and adaptations to help it eat specific things and live in specific places!

***Take it to the next level!*** *Learn more what aquatic macroinvertebrates can tell you about water quality:*

Looking at what species of macroinvertebrates are in water can tell us how healthy the water is. Some species of macroinvertebrates, called bioindicators, are able to tolerate very polluted water, while others are very sensitive and need clean water. This graphic shows a few macroinvertebrates that tolerate different levels of water quality.

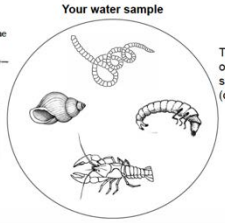
***Look at the water sample below. Using the graphic on the left, circle the word that best describes your sample.***

**Pollution sensitive (good water quality)**




**Pollution tolerant (poor water quality)**

**Your water sample**



The quality of my water sample is (circle one):

**Good**

**Okay**

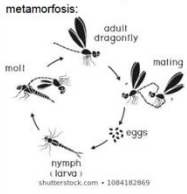
**Poor**

Find out more about the Bosque Ecosystem Monitoring Program at www.bemp.org! Tell us what you thought about this activity at https://tinyurl.com/bemp-survey

## Macroinvertebrados Acuáticos (¡para todas las edades!)

Además de los artrópodos (insectos) en la tierra, ¡hay muchos artrópodos que viven en el agua! Estos son llamados **invertebrados acuáticos.** Los invertebrados acuáticos tienen ciclos de vida interesantes y pueden darnos información sobre cuán saludable es el agua. ¡Estas actividades se enfocarán en los invertebrados acuáticos que puedes ver sin un microscopio, llamados **macroinvertebrados!** ¿Has visto un macroinvertebrado antes? ¡Cangrejos son macroinvertebrados acuáticos muy comunes!

Muchos macroinvertebrados sufren **metamorfosis,** o cambios físicos a medida que se convierten en adultos. Animales como ranas y mariposas pasan por la metamorfosis. Echa un vistazo a éste gráfico para ver cómo macroinvertebrados experimentan metamorfosis:




Antes de que un invertebrados se transforma en adulto, es llamado **larva.** Algunas veces, larvae y adultos de la misma especie parecen muy diferentes. Después de echar una mirada a ésta larva macroinvertebrado enseguida, ¡dibuja cómo piensas que se mirará su versión adulta!

- ¿Qué come tu adulto??
- ¿Dónde vive?
- ¿Cuál es su nombre?

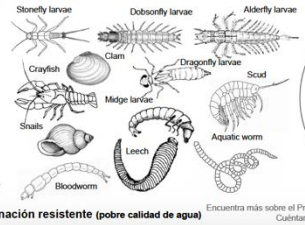
*¡El adulto debe tener partes del cuerpo y adaptaciones especiales para ayudarlo a comer cosas específicas y vivir en lugares específicos!

***¡Llévalo al siguiente nivel!*** *Aprende más acerca de lo que los macroinvertebrados acuáticos pueden decirte acerca de la calidad del agua:*

Mirando qué especies de macroinvertebrados hay en el agua puede decirnos qué tan saludable es el agua. Algunas especies de macroinvertebrados, llamados bioindicadores, están capacitados para tolerar agua muy contaminada, mientras que otras son muy sensibles necesitan agua limpia. Este gráfico muestra algunos macroinvertebrados que toleran diferentes niveles de calidad del agua.

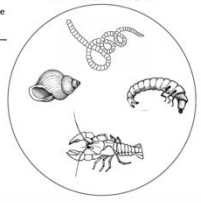
***Mira la muestra de agua a continuación. Usando el gráfico de la izquierda, encierra la palabra que mejor describa tu muestra.***

**Contaminación sensitiva (buena calidad de agua)**




**Contaminación resistente (pobre calidad de agua)**

**Tu muestra de agua**



La calidad de mi muestra de agua es: (encierra una):

**Buena**

**Aceptable**

**Pobre**

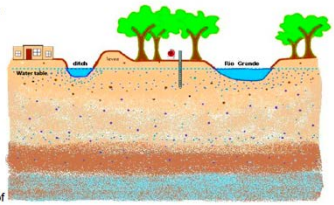
Encuentra más sobre el Programa de Monitoreo de Ecosistemas de Bosque en: www.bemp.org! Cuéntanos qué te pareció esta actividad en: https://tinyurl.com/bemp-espanol

## BEMP Groundwater Monitoring

Each month, BEMP checks how deep the water in the ground below us is. Why would we do that? What uses underground water? Plants, like native cottonwood trees, use **groundwater** to survive and need to have enough water to grow. We (humans!) also use this water for drinking or to grow our food. By monitoring groundwater, we can learn more about the health of our bosque, Rio Grande, and ecosystems we call home. **Check out this activity to learn more about groundwater!** (This activity was adapted from The Chaos and the Cutter's lesson "Simple Science: Groundwater" and The Groundwater Foundation's "Aquifer in a cup")

**Create your own aquifer:**

1. Find a tall, large, clear container that you and your family doesn't mind having sand and rocks in.
2. To make the **aquifer** (the layer of sand and rocks underground that holds water), fill the container with alternating sand and rocks (**sediment**).
3. Fill the container with water, until it is an inch away from the top of the rocks and soil. This is called the **water table**.
4. Add a bit more water and pretend it is raining. What happens to the water table? This is how water enters the aquifer!
5. Keep adding water until it has reached the top of the sediment. The water above the sediment is called **surface water**.




***Take it to the next level!***

*Here are some things you can do to learn more about how plants and people use groundwater:*

The Rio Grande cottonwood, a native tree in the bosque, needs their roots in or near the water table. The roots of a cottonwood go about 3 meters (300 centimeters or about 10 feet) underground. Each month, BEMP measures the groundwater throughout the bosque. **Using the provided BEMP data, answer the following questions:**

1. BEMP measures the groundwater in the winter, and the water is 350 cm away from the surface. Are the roots of the cottonwoods able to reach the water? What might happen to the cottonwood trees?

2. BEMP measures the groundwater in the spring, and the water is 100 cm away from the surface. Are the roots of the cottonwoods able to reach the water? What would happen to the cottonwood trees?

**What happens when you remove water from your aquifer?** Use a clean soap or lotion pump to remove water from the system. Why do we pump water from the ground? How would this affect the plants that need the water?

**What happens if a pollutant like motor oil gets washed into the aquifer?** Add a few drops of food coloring to your aquifer. How does it spread? Does it take a long time to get to the bottom of your model? What can you do to prevent the spread of pollutants into the aquifer?

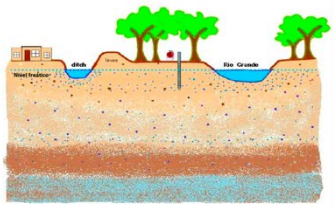
Find out more about the Bosque Ecosystem Monitoring Program at www.bemp.org! Tell us what you thought about this activity at https://tinyurl.com/bemp-survey

## BEMP Monitoreo del agua subterránea

Cada mes, BEMP comprueba la profundidad del agua debajo de nosotros. ¿Por qué haríamos eso? ¿Qué usa el agua subterránea? Plantas, árboles nativos como los Álamos, usan el agua **subterránea** para sobrevivir y la suficiente agua para crecer. Nosotros (¡Los humanos!) también la usamos para beber o para cultivar nuestra comida. Monitoreando las aguas subterráneas, podemos aprender sobre la salud de nuestro bosque, Río Grande, y los ecosistemas que llamamos hogar. **¡Mira ésta actividad para aprender más sobre el agua subterránea!** (Ésta actividad fue adaptada de las lecciones The Chaos and the Cutter "Ciencia simple: agua subterránea" y "Acuífero en una vaso" de la Fundación de Agua Subterránea).

**Crea tu propio acuífero "manto de agua":**

1. Encuentra un recipiente transparente, alto y largo en el que tú ni tu familia no les importe tener arena y rocas.
2. Para hacer el acuífero (las capas de arena y rocas bajo tierra que retienen agua), llena el recipiente con arena y rocas alternadas (**sedimento**).
3. Llena el recipiente con agua, hasta que esté a una pulgada de distancia de la parte superior de las rocas y el suelo. Ésto es llamado **nivel freático:tabla de agua**.
4. Agrega un poco más de agua y pretende que está lloviendo. ¿Qué pasa con el nivel freático? ¡Así es como el agua entra al acuífero!
5. Continúa agregando agua hasta que haya alcanzado la parte superior del sedimento. El agua sobre el sedimento es llamada **agua superficial.**




***¡Llévalo al siguiente nivel!***

*Aquí hay algunas cosas que puedes hacer para aprender más acerca de cómo plantas y personas usan el agua subterránea:*

El álamo del Río Grande, árbol nativo en el bosque, necesita sus raíces dentro o cerca de la mesa de agua. Las raíces del álamo van casi 3 metros (300 centímetros, más o menos 10 pies) bajo tierra. Cada mes, BEMP mide el agua subterránea a lo largo del bosque. **Usando los datos proporcionados por BEMP, responde las siguientes preguntas.**

1. BEMP mide el agua subterránea en el invierno, y el agua está a 350 cm de distancia de la superficie. ¿Las raíces de los álamos son capaces de alcanzar el agua? ¿Qué podría pasar con los álamos?

2. BEMP mide el agua subterránea en la primavera, y el agua está a 100 cm de distancia de la superficie. ¿Pueden las raíces de los álamos alcanzar el agua? ¿Qué podría pasar con los álamos?

**¿Qué pasa cuando sacas agua de tu acuífero?** Usa un dispensador de bomba de jabón o loción limpio para sacar agua del sistema. ¿Por qué bombeamos agua del suelo? ¿De qué manera podría afectar esto a las plantas que necesitan el agua?

**¿Qué pasa si un contaminante como el aceite de motor es lavado en el acuífero?** Agrega algunas gotas de colorante comestible a tu acuífero. ¿Cómo se extiende? ¿Toma ésto mucho tiempo para llegar a la base de tu modelo? ¿Qué puedes hacer para prevenir la extensión de los contaminantes dentro del acuífero?

Encuentra más sobre el Programa de Monitoreo de Ecosistemas de Bosque en: www.bemp.org!
Cuéntanos qué te pareció esta actividad en: https://tinyurl.com/bemp-espanol

## APPENDIX F: PHOTOS*

*All photos used with student permission

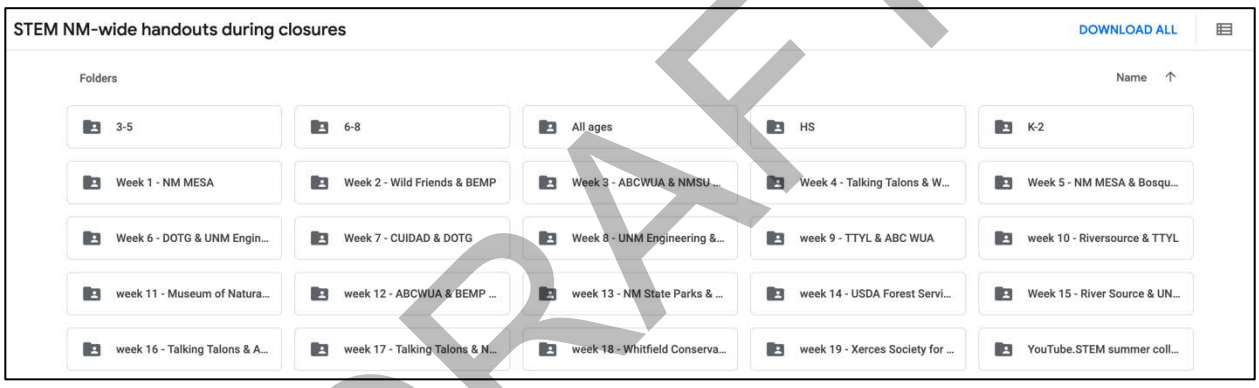
Watershed model at Bosque School


Study Trip Water Quality analysis with multiparameter sonde

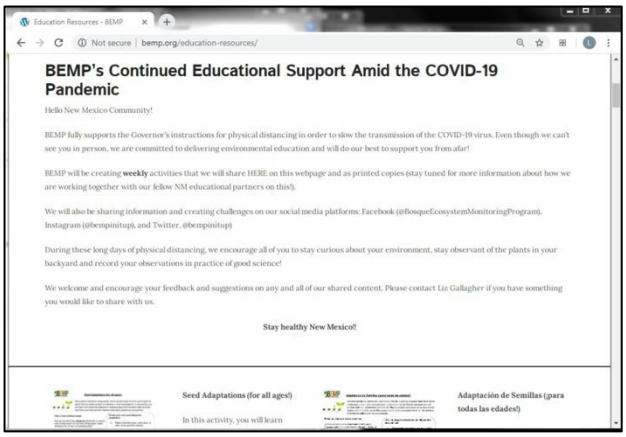
Study Trip with Bosque School– Water Quality analysis at the river and arroyo system

Monthly Monitoring activity

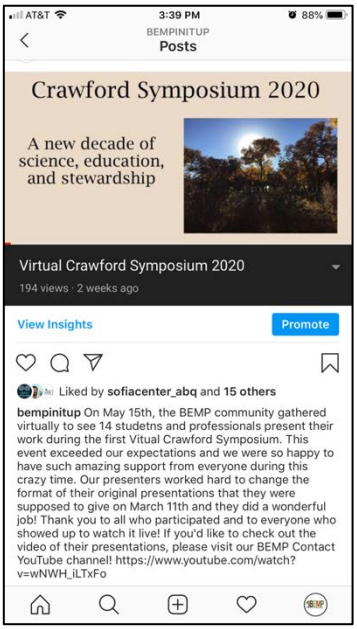
Use of the *Plickers* assessment tool during a study trip



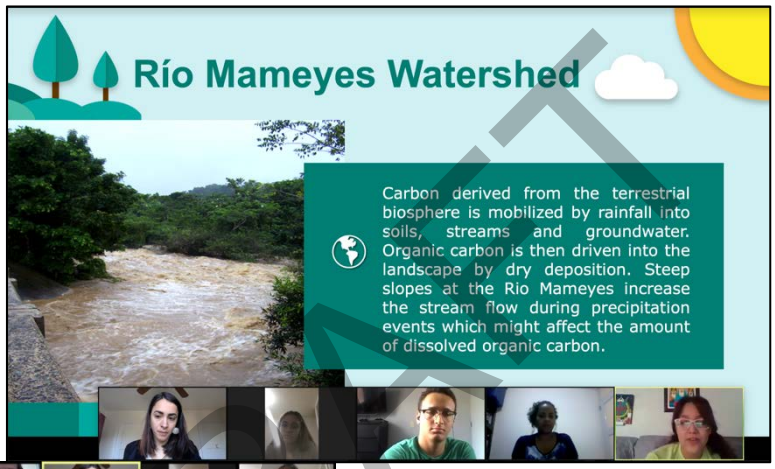

STEM organizations BEMP partners with for the Grab & Go meal program (NMSU Nature Matters Academy, Whitfield WCA, Bosque School Math, DOTG, UNM Engineering, CIUDAD, Cottonwood Gulch, Talking Talons Youth Leadership, RiverSource, Museum of Natural History, NM State Parks, Wild Friends, USDA Forest Service, Mesa Prieta Petroglyph Project and Xerces Society for Invertebrate Conservation).

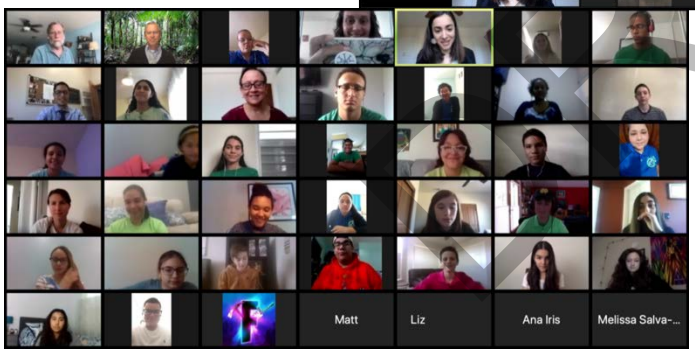



Activities posted on BEMP's website




Announcement of the Virtual Crawford Symposium 2020 on Instagram




Luquillo-Sevilleta Virtual Symposium 2020 – presentation and some participants


Water Wednesday posted on Instagram

## APPENDIX G: 2019-2020 STORMWATER SCIENCE EDUCATION OUTREACH NUMBERS

### 1. Pre-COVID-19 school year

| Date | School/Event name | County | Students | Adults | Grade | Activity | Presentations |
|---|---|---|---|---|---|---|---|
| 12/9/19 | West Mesa HS | Bernalillo | 3 | 1 | 9-12 | BASS | 1 |
| 9/11/19 | The International School | Bernalillo | 34 | 1 | 6-8 | Classroom | 2 |
| 9/16/19 | The International School | Bernalillo | 32 | 1 | 6-8 | Classroom | 2 |
| 12/9/19 | Bosque School | Bernalillo | 33 | 1 | 6-8 | Classroom | 2 |
| 12/9/19 | Bosque School | Bernalillo | 34 | 1 | 6-8 | Classroom | 2 |
| 12/12/19 | Bosque School | Bernalillo | 30 | 1 | 6-8 | Classroom | 2 |
| 2/10/20 | Cien Aguas International School | Bernalillo | 45 | 1 | 6-8 | Classroom | 2 |
| 2/11/20 | Cien Aguas International School | Bernalillo | 37 | 1 | 6-8 | Classroom | 2 |
| 10/21/19 | Rio Rancho schools/Children's Water Festival | Sandoval | 150 | 6 | 3-5 | Event | 6 |
| 10/22/19 | Rio Rancho schools/Children's Water Festival | Sandoval | 150 | 6 | 3-5 | Event | 6 |
| 9/16/19 | La Academia De Esperanza (LADE) | Bernalillo | 5 | 0 | 9-12 | Monthly Monitoring | 1 |
| 1/23/20 | Cottonwood Valley Charter School | Socorro | 18 | 3 | 3-5 | Monthly Monitoring | 1 |
| 8/16/19 | Amy Biehl HS | Bernalillo | 25 | 3 | 9-12 | Other | 1 |
| 9/13/19 | Amy Biehl HS | Bernalillo | 21 | 2 | 9-12 | Other | 1 |
| 11/1/19 | Bosque School | Bernalillo | 11 | 1 | 6-8 | Other | 1 |
| 11/4/19 | Bosque School | Bernalillo | 1 | 0 | 9-12 | Other | 1 |
| 11/8/19 | Amy Biehl HS | Bernalillo | 26 | 2 | 9-12 | Other | 1 |
| 12/6/19 | Amy Biehl HS | Bernalillo | 27 | 2 | 9-12 | Other | 1 |
| 12/11/19 | Bosque School, Nambe Pueblo, Pueblo of Sandia, other Pueblo representatives | Nambe Pueblo | 1 | 21 | 9-12 | Other | 1 |
| 1/8/20 | Bosque School | Bernalillo | 15 | 1 | 6-8 | Study Trip | 1 |
| 1/9/20 | Bosque School | Bernalillo | 16 | 1 | 6-8 | Study Trip | 1 |
| 1/15/20 | Bosque School | Bernalillo | 11 | 1 | 6-8 | Study Trip | 1 |
| 2/4/20 | Bosque School | Bernalillo | 11 | 1 | 6-8 | Study Trip | 1 |
| **TOTAL** | | | **736** | **58** | | | |

*Other activities included a variation of the regular study trip, independent research projects or presentation of any stormwater science curriculum to a conference.

## 2. During COVID-19 closures

| Date | School/Event name | County | Students | Adults | Grade | Activity | Presentations | Activity name /Comments |
|---|---|---|---|---|---|---|---|---|
| 4/8/2020 | Van Buren MS | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Arroyo Del Oso ES | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Inez ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Comanche ES | Bernalillo | 240 | 1 | K-12 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Sombra del Monte ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Inez ES | Bernalillo | 10 | 1 | K-5 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Comanche ES | Bernalillo | 10 | 1 | K-5 | Grab & Go | n/a | Stormwater and Pollution |
| 4/8/2020 | Sombra del Monte ES | Bernalillo | 10 | 1 | K-5 | Grab & Go | n/a | Stormwater and Pollution |
| 4/24/2020 | Luquillo-Sevilleta Virtual Symposium | Bernalillo/Puerto Rico | 31 | 19 | 6-8 | Grab & Go | 6 | 8 views as of 7/2/20 |
| 4/29/2020 | Van Buren MS | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Arroyo Del Oso ES | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Inez ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Comanche ES | Bernalillo | 240 | 1 | K-12 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Sombra del Monte ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Inez ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Comanche ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Sombra del Monte ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | Groundwater |
| 4/29/2020 | Little Libraries | Bernalillo | 30 | 0 | K-12 | Grab & Go | n/a | Groundwater |
| 5/14/2020 | Van Buren MS | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Arroyo Del Oso ES | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Inez ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Comanche ES | Bernalillo | 240 | 1 | K-12 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Sombra del Monte ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Inez ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Comanche ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Sombra del Monte ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | SWS: What the poop! |
| 5/14/2020 | Little Libraries | Bernalillo | 50 | 0 | K-12 | Grab & Go | n/a | SWS: What the poop! |
| 5/15/2020 | Crawford Symposium | YouTube | 8 | 4 | All | Event | 58:33 min | 60 people participated in the live event, 210 views as of 7/2/2020 |
| 5/20/2020 | Van Buren MS | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Arroyo Del Oso ES | Bernalillo | 300 | 1 | K-12 | Grab & Go | n/a | Aquatic Invertebrates |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5/20/2020 | Inez ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Comanche ES | Bernalillo | 240 | 1 | K-12 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Sombra del Monte ES | Bernalillo | 150 | 1 | K-12 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Inez ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Comanche ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Sombra del Monte ES | Bernalillo | 10 | 1 | K-6 | Grab & Go | n/a | Aquatic Invertebrates |
| 5/20/2020 | Little Libraries | Bernalillo | 50 | 0 | K-12 | Grab & Go | n/a | Aquatic Invertebrates |
| 6/1/2020 | Storytime in the Park | Bernalillo | 750 | n/a | K-12 | Event | n/a | Stormwater and Pollution |
| 6/8/2020 | Horizons | Bernalillo | 100 | n/a | K-12 | Horizons | n/a | Horizons week 2 activity G&G- Stormwater |
| 6/10/2020 | Horizons | Bernalillo | 3 | n/a | 6-8 | Horizons | 1 | In-person zoom sessions |
| 6/17/2020 | Horizons | Bernalillo | 9 | 3 | K-8 | Horizons | 1 | In-person zoom sessions |
| 6/18/2020 | SWS video | YouTube | n/a | n/a | K-12 | YouTube channel | 3:02 min | Raindrop journey and pollution activity video - 13 views as of 7/3/20 |
| 7/6/2020 | Horizons | Bernalillo | 100 | n/a | K-12 | Horizons | n/a | Horizons week 6 activity G&G - Groundwater |
| **TOTAL** | | | **5811** | **58** | | | | |

NOTE: Number of students/adults was estimated the based on the number of printed activities.

Letter regarding FY20 compliance monitoring placeholder