

Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA

Prepared for:

Bureau of Reclamation

By:

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Technical Proposal

Executive Summary

Southwest Research Institute (SwRI), located in San Antonio, Texas requests funding from the US Bureau of Reclamation (BOR) to support our work with Middle Pecos Groundwater Conservation District (MPGCD), Reeves County Groundwater Conservation District (RCGCD), and The Nature Conservancy (TNC). This collaborative effort proposes to generate robust geochemical datasets required to (i) understand and conceptualize complex surface-water/groundwater flow regimes; (ii) identify sources of springs and recharge areas; (iii) provide estimates of available groundwater while insuring water resources are sustainable; and (iv) assemble a geochemical framework model that can serve as an indicator of impacts to water resources due to changes in land use and climate. Specifically, the proposed study will determine if changes in geochemical signatures in spring discharge are precursors for changes in recharge caused by changes in land use and/or climate. Funds committed by BOR will be used to pay for the collection, compilation, and interpretation of geochemical data from springs and groundwater wells in Culberson, Reeves, Jeff Davis, and Pecos counties in west Texas. Geochemical frameworks assembled for the major spring systems in the arid and semi-arid study area will provide an opportunity to ascertain the complex surface-water/groundwater regimes which sustain the springs. Such determinations made by the application of a geochemical frameworks will allow water resource managers to make better informed decisions for desert communities that will help them insure that future water resources are sustainable.

Project Description

The objective of the proposed BOR Applied Science Grant is to use in-depth and robust geochemical characterizations of groundwater to constrain local and regional flow paths that provide recharge to two iconic and interconnected spring systems in west Texas: San Solomon Springs in Balmorhea and Comanche Springs in Fort Stockton. Both spring systems are discharge points for a regional flow system that originates in Jeff Davis, Culberson, Reeves, and possibly additional counties. Complex recharge-discharge relations that manifest in spring discharge and along groundwater flow paths can be better understood using a geochemical framework. This framework provides constraints on source rock types, modern and submodern recharge, and temporal variability. Source areas for spring recharge can be identified using the endmember chemistry ascertained for each source area using mixing and reaction-path models and analysis.

This study proposes the application of a geochemical framework to determine if changes in geochemistry in spring discharge are precursors for changes in recharge caused or influenced by changes in land use and climate. A geochemical framework is a structured approach that utilizes geochemical analyses, statistical analyses, and geochemical modeling to identify different groundwater source areas and flow paths to discharge points (e.g., springs, wells). The application of a geochemical framework provides: 1) a means to differentiate mixing and flow path characteristics that may contribute to the hydrochemical signature of groundwater; and 2) a method to explain



temporal variability in spring discharge. An integral part of the geochemical framework is the collection and interpretation of robust geochemical data. In the context of this study, “robust” is characterized by: 1) the collective use of an extensive suite of geochemical constituents (i.e., ions, isotopes, physiochemical parameters); 2) an extensive spatial coverage over a large geographic area; and 3) the establishment of time series data by multiple geochemical data collections over time. Data collection for this area to these standards are limited but necessary to better understand complex recharge-discharge relationships, such as those that characterize west Texas flow systems.

If the hydrochemical signature manifested in spring discharge changes from current observations or background conditions, the tools assembled during this project will enable identification of which endmember(s) (i.e., source area) has/have caused change in chemistry (i.e., from altered or diminished flow). This will be achieved by generating the robust geochemical datasets required to: (i) understand and conceptualize complex surface-water/groundwater flow regimes; (ii) identify sources of springs and recharge areas; (iii) provide estimates of available groundwater while insuring water resources are sustainable; and (iv) assemble geochemical framework models that can serve as an indicators of impacts to water resources due to changes in land use and climate. The breadth of robust geochemical data currently available will be expanded by collecting additional samples from the spring systems and contributing aquifers in Culberson, Reeves, Jeff Davis, and Pecos counties. Mixing and reaction-path models generated with these expanded datasets will provide the tools needed to ascertain how diminished (or increased) flow rates to discharge areas (i.e., springs) caused by changes in land use (e.g., pumping) and climate (e.g., changes in precipitation) may affect spring discharge hydrochemistry.

Geochemical results will be interpreted to inform specific study questions related to aquifer properties and springflow, including: (i) identifying the source area of spring discharge, which will assist in identifying endmember hydrochemistry; and (ii) discerning the contributions of various aquifers and specific flow paths to springs, in particular discharge at both the San Solomon and Comanche spring systems located in semi-arid west Texas. The work described in this proposal will contribute to developing hydrologic information and water management tools and improve modeling and forecasting capabilities, which may be used by water managers to increase water supply reliability and enable conjunctive use of groundwater and surface water.

Project location

The project location will focus on two iconic and interconnected spring systems in west Texas: San Solomon Springs in Balmorhea and Comanche Springs in Fort Stockton (Figure 1). San Solomon Springs includes Phantom Lake, Giffin, San Solomon, West Sandia, East Sandia, and Saragosa springs. Springs of interest in Fort Stockton include Comanche, Diamond Y, and Euphrasia springs.

Both spring systems are discharge points for a regional flow system that originates in Culberson, Jeff Davis, Reeves, and possibly additional counties. These spring systems provide an attractive location for the application of geochemical frameworks because the springs are: (i) iconic water features in an arid to semi-arid environment with minimal



recharge; (ii) central to the economic viability of the local communities; (iii) subject to threats from increased water demands due to potential increases in agricultural, oil/gas, and population; and (iv) subject to several recent and ongoing investigative studies fueled by their recognized importance.

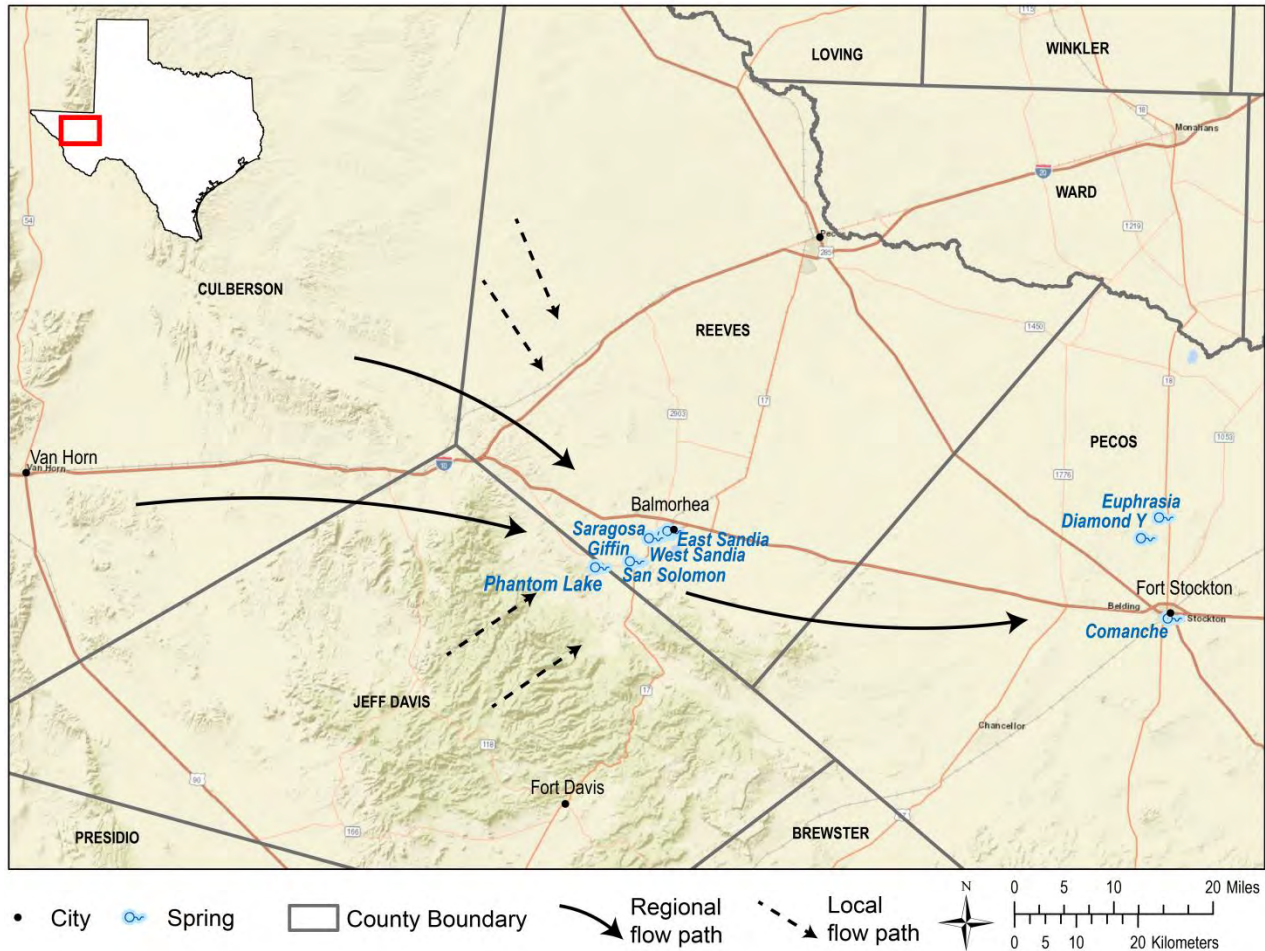


Figure 1. Area of interest for the proposed study. Generalized local and regional flow paths have previously been discerned using geochemical analyses (Uliana et al., 2007; Nunu and Green, 2020) but are still not well constrained.

Data Management Practices

All spatially explicit data or tools developed in the performance of an award made under this NOFO will be developed in industry standard formats that are compatible with Geographic Information System (GIS) platforms. Specifically, the project team will develop data and tools using Esri ArcGIS Desktop Version 10.5 or newer.

Evaluation Criteria

Evaluation Criterion A — Benefits to Water Supply

Describe the water management issue (s) that your project will address. For example, will your project address water supply shortfalls or uncertainties, the need to meet competing demands for water, complications arising from drought, conflicts over water, or other water management issues? Describe the severity of the water management issues to be addressed through your project.

Spring systems in arid and semi-arid environments are threatened by changes in land use (e.g., irrigation practices, pumping for oil and gas development) and climate (e.g., recharge from precipitation). In some instances, spring systems have already been impacted by water management data and methods that are not adequate for the highly variable mean annual recharge in this arid to semi-arid region.

Communities reliant on the groundwater resources that feed these spring systems, as well as communities that are dependent upon irrigating crops with spring discharge or recreation associated with these springs, are faced with challenging decisions when attempting to balance economic growth with sustaining spring discharge and groundwater availability. It is imperative to understand how and from where springs are sourced, how spring discharge will respond to changes in land use and climate, and how much water will be available for economic development while guaranteeing that spring discharge and water availability for other needs. Meeting these challenges would benefit from improved applied science tools based on expanded databases. By understanding where recharge comes from, where it goes, and how much water will be available in light of changes in land use and climate will enable the communities to take water-resource management actions to help: (i) avoid future water supply shortfalls; (ii) avoid unnecessary competing demands and conflicts over water; and (iii) mitigate complications from drought.

Generation of the proper geochemical framework and understanding the implications of changes in the hydrochemistry of spring discharge will provide the foundation for this understanding. Water management tools and the supporting databases provided by this project will provide the basis to reduce uncertainty by allowing water resource managers to make better informed resource management decisions. Currently, in the proposed study area, neither the applied science water management tools nor the supporting databases are available for use by the water resource managers. This project will compile the requisite data and the applied science tools for use by these decision makers.

Many spring systems in arid and semi-arid environments are aptly considered iconic particularly if the springs are perennial, prolific, and found in desert settings. There are many examples where such iconic springs have succumbed to significantly diminished flow or completely ceased flowing due to unconstrained groundwater development (e.g., Comanche Spring and Phantom Lake Spring were perennially flowing springs prior to development of neighboring communities and agricultural activities). The economies and quality of life in such cases have suffered substantially. Providing communities that



are reliant on iconic and desert spring systems with applied science tools and the requisite supporting databases will enable water resource managers the ability to make informed decisions to insure the future sustainability of these water resources in response to longterm changes in land use and climate.

Explain how your project will address the water management issues identified in your response to the preceding bullet.

The project wil address the following water management issues: (a) water supply reliability; (d) drought management activities; (g) ability to meet endangered species requirements; (h) watershed health; and (i) conservation and efficiency (Table 1).

Table 1. Water management issues addressed by the proposed project.

Funding Opportunity goal	Contribution of proposed project to Funding Opportunity goal
Water supply reliability	See below
Drought management activities	See below
Ability to meet endangered species requirements	The proposed effort will provide a means to determine how changes in spring discharge may impact spring hydrochemistry. The project will predict how water quality properties that currently sustain federally endangered species inhabiting the springs may be impacted by
Watershed health	Project will provide insight on watershed health (as indicated by flow of water and specific flow paths that supply water). This is measured by the quantity of water discharged to springs as well as the changes in the hydrochemical species. Application of a geochemical framework will provide an early warning to protect springs using geochemical markers as indicators.
Conservation and efficiency	See below

Describe to what extent your project will benefit one of the water management objectives listed in the preceding bullets. In other words, describe the significance or magnitude of the benefits of your project, either quantitatively or qualitatively, in meeting one or more of the listed objectives.

In the absence of knowing which source areas and aquifers provide input for which springs, water-resource managers are hard pressed when making informed decisions regarding the future sustainability and reliability of water supplies. This uncertainty is exacerbated when changes in land use and climate are involved. Compilation of robust temporal and spatially extensive geochemical databases enables assembly of geochemical frameworks that constrain conceptual and numerical models of cause(s) of changes in spring discharge chemistry. Assembly of the geochemical framework and the associated database will enable the water managers to ensure water supplies are

sustainable in the event of sustained drought or other changes that may impact water supply reliability. Delineating the flow regimes from recharge to discharge will also enable water resources to be efficiently exploited and conserved.

Explain how your project complements other similar applicable to the area where the project is located. Will your project complement or add value to other, similar efforts in the area, rather than duplicate or complicate those efforts? Applicants should make a reasonable effort to explore and briefly describe related ongoing projects.

Challenges to the water resources of the San Solomon Spring system near Balmorhea and the greater Comanche Springs system near Ft Stockton in west Texas are well known. Texas Water Trade (TWT), in collaboration with the Meadows Center for Water and the Environment, is exploring the prospect of restoring perennial flow at Comanche Springs. Succinctly stated, the focus of their efforts is to identify and retire pumping rights in the Belding irrigation area located west and upgradient from Comanche Springs with the hope that reduced groundwater extraction will result in increased spring discharge. TWT was awarded a BOR Applied Science grant to pursue this endeavor. The SwRI project team is assisting TWT and the Meadows Center in the administration of their efforts. This proposed project will directly benefit this ongoing work by providing insight into the regional flow system (or systems) which provides recharge to Management Area 1 and Comanche Springs, the focus of the TWT BOR Applied Science project.

In 2016, Apache Corporation announced development of the Alpine High oil/gas play that was centered in Reeves and Pecos counties. The proposed development elicited concerns by many in the community that development of the Alpine High play would have detrimental impacts on the San Solomon Springs system and possibly other water resources of the area. In addition to technical evaluations by local non-governmental organizations (i.e., the Big Bend Conservation Alliance retained SwRI to conduct one such evaluation), Apache Corporation funded the National Cave and Karst Research Institute (NCKRI) and the University of Texas-Bureau of Economic Geology (BEG) to conduct water resource evaluations. In early 2020, Apache Corporation ceased development of the Alpine High field. As a results, project activities by NCKRI and BEG have been curtailed to some degree. Our project team is in communication with these researchers, however, at this time the future of these efforts is uncertain given the abandonment of the Alpine High field development.

SwRI is a private 501(c)(3) research institute. Its mission is benefit government, industry, and the public through innovative science and technology. In 2020, SwRI awarded the project team an internal research grant for \$285,000 to develop geochemical framework tools to better conceptualize the surface-water/groundwater regimes that sustain complex spring systems, focusing on arid and semi-arid environments. Tools and databases developed by our internal research project provide the foundation for this BOR Applied Science grant proposal. In addition, this internally funded project spurred collaboration between the project team with a broad range of stakeholders and fellow researchers active in the study area. Several of these stakeholders have committed support to this proposal including the Middle Pecos and



Reeves County GCDs, The Nature Conservancy (TNC), and the Environmental Defense Fund.

Middle Pecos GCD in Pecos County has actively managed its water resources for several decades. These efforts focus on Management Area 1, which encompasses Comanche Spring and the Belding irrigation district located west of Ft Stockton that is home to several thousand acres of pecan orchards and other crops. Water resource management of this area has been the subject of multiple legal actions, some of which continue today. As part of efforts to manage its resources, Middle Pecos GCD has undertaken projects to improve its understanding of the geology and hydrogeology of Management Area 1 with the development of a new three-dimensional geologic framework model and an associated numerical groundwater model. The models only cover Management Area 1 and rely on adjoining conceptualizations for boundary conditions. Middle Pecos GCD is collaborating with the current SwRI-funded project by providing access to local wells and springs and funding the analytical costs of selected water samples collected in Management Area 1.

Investigation and protection of the ecological health of springs in the targeted study area is led by The Nature Conservancy (TNC) and Texas Parks and Wildlife Department. TNC has established preserves to protect the minor springs in the Balmorhea area (i.e., East and West Sandia springs) and Ft. Stockton (i.e., Diamond Y and Euphrasia springs). TNC is working closely with the current SwRI-funded project by providing access to springs on its preserves and funding the analytical costs of selected water samples collected at the preserves.

The BOR Applied Science project described in this proposal will not duplicate any of the aforementioned projects. Rather, our proposed Applied Science project will implement the geochemical framework tools developed using internal SwRI funds to assist stakeholders in the study area to: (i) identify the source (recharge) areas of springs; (ii) identify the flow regimes that sustain the springs; (iii) formulate mixing and reaction-path models of the multiple sources of recharge to complex spring systems; and (iv) help establish guidance on how changes in land use and climate will impact the water budgets that sustain the springs. The ongoing TWT BOR Applied Science project addresses some of these objectives for Management Area 1 in Pecos County. Our proposed BOR Applied Science grant will incorporate the findings of the TWT project into the regional-scale study area of this project. The products provided by this proposed project will add to and not duplicate the TWT project by providing a regional scope to its efforts.

Although discharge from two major spring systems (i.e., San Solomon and Comanche) will be targeted during this study, the efficacy of the approach will encourage its application at other spring systems located in arid and semi-arid environments.



Evaluation Criterion B — Need for Project and Applicability of Project Results

Will the project result in an applied science tool(s) or information that is readily applicable, and highly likely to be used by water resource managers in the West?

Yes, the project will result in an applied science tool and information that are readily applicable, and highly likely to be used by water resource managers not only in the study area, but also in other localities in arid and semi-arid environments whose communities and economies are reliant on spring systems. The project team already works closely with the water resource managers in the study area. The applied science water chemistry tools and the supporting databases will be provided to these managers to enable them to make better informed water resource management decisions compared to making these decisions without these project products. All data will be provided in publically available databases and GIS-compatible formats.

Explain who has expressed the need and describe how and where the need for the project was identified (even if the applicant is the primary beneficiary of the project). For example, was the need identified as part of a prior water resources planning effort, determined through the course of normal operations, or raised by stakeholders? Provide support for your response (e.g., identify the entities that have expressed a need or cite planning or other documents expressing a need for the project).

Entire communities in arid and semi-arid environments are dependent on the water resources provided by desert spring systems. For the study area of this project which includes the springs at Balmorhea and the springs in Ft. Stockton, stakeholders who have expressed concern about the future sustainability of the springs include groundwater conservation districts (Reeves County GCD, Middle Pecos GCD), city mayors (Balmorhea), and non-governmental organizations (Environmental Defense Fund, The Nature Conservancy, The Meadows Center for Water and the Environment).

Will the results of your project inform water resource management actions and decisions immediately upon completion of the project, or will additional work be required?

The principal products of the project will be tools and a supporting database that will assist policy makers when making water resource management decisions. Complementary and supporting products will be guidance available to stakeholders to effectively use the tools and databases. Currently, there are insufficient data and conceptualizations of the surface water/groundwater systems that sustain the iconic springs in these arid and semi-arid environments; those that do exist are poorly constrained. The database and tools developed during this project will greatly inform the resource allocation decisions made by water resource managers by having improved conceptualizations of their water resources (i.e., recharge rates, impacts of changes in land use and climate on available recharge, how the hydrochemistry of spring discharge can portend changes in recharge to the springs). Although additional data and future improvements in conceptualizations would enhance the tools developed in the proposed



project, no additional work will be required to effectively use the products developed by this project.

If applicable, will the results of your project be transferrable to other users and locations? Note: not all water management solutions are transferrable

Yes, the results of this project would be transferrable and informative for other water resource managers in semi-arid areas and karstic aquifer systems like the Edwards-Trinity aquifer system in central Texas. All data will be provided in publically available databases and GIS-compatible formats.

If the applicant is not the primary beneficiary of the project (e.g., Category B applicant), describe how the project beneficiaries have been or will be involved in planning and implementing the project?

SwRI (Category B Applicant) has collaborated with many of the beneficiaries of this project for the past several years. In particular, both Category A entities (Middle Pecos GCD and Reeves County GCD) who are partnering on this grant application and The Nature Conservancy have assisted the project team in gaining access to wells and springs to allow site inspection and water sample collection. This assistance is important given that many sample locations are remote and some are located on private lands. Site access can prove to be a project breaker if local collaborators are not on the team. Wells and springs that have been identified for inclusion in the project will be selected after consultation with the two GCDs and The Nature Conservancy.

Evaluation Criterion C – Project Implementation

Briefly describe and provide support for the approach and methodology that will be used to meet the objectives of the project.

The geochemical assemblage of any spring, river, or groundwater sample comprises isotopes, ions, and trace elements. Collectively, these geochemical constituents leave water with a hydrochemical "fingerprint" that can distinguish it from other waters with different histories or flow paths (Ladouche et al., 2001). Numerous techniques, or baseline analyses, will be employed to visualize and interpret these hydrochemical fingerprints using previously compiled and synthesized geochemical data.

The Geochemist's Workbench[®] 14 software (Bethke, 2008; Bethke et al., 2020) will be used to generate cross-plots, box plots, and trilinear diagrams to provide graphical comparisons of the samples. Datasets include major and minor ion concentrations (i.e., calcium, magnesium, sodium, potassium, chloride, bicarbonate, sulfate, strontium, fluoride), physiochemical indicators (i.e., pH, temperature, dissolved oxygen, field alkalinity), and trace elemental concentrations (e.g., barium, bromide, vanadium, zinc) from springs and groundwater wells. Datasets also include a robust suite of isotopes that are commonly used in water resource assessments and whose applications are outlined in Table 2.



Table 2. Isotopes that are commonly used in water resource assessments and will be employed in the geochemical framework proposed in this study.

Isotope	Description of hydrochemical application	Examples of hydrochemical application
<i>Stable Isotopes</i>		
Carbon-13 ($\delta^{13}\text{C}$) of Dissolved Inorganic Carbon (DIC) in water	Distinguish between sources of microbial activities, vegetation, carbonate or similar host rocks, soils	Knierim et al. (2013); Nunu et al. (2019)
Oxygen-16/17/18 ($\delta^{16}\text{O}$, $\delta^{17}\text{O}$, $\delta^{18}\text{O}$)	Stable isotopes of water; measure long term climate trends such as changes in ocean temperature, ice sheets, precipitation; Global Meteoric Water Line	Craig (1961); Uliana et al. (2007); Knierim et al. (2013); Surma et al. (2015); Bao et al. (2016)
Deuterium ($\delta^2\text{H}$)	Stable isotope of water; $^2\text{H}/^1\text{H}$ ratio; Global Meteoric Water Line	Craig (1961); Ladouche et al. (2001); Uliana et al. (2007);
Boron-11 ($\delta^{11}\text{B}$) of dissolved boron	Discern between natural (e.g., host rocks, salts) and anthropogenic sources (e.g. sewage effluent, sodium perborate from bleaching agents) of boron compounds	Vengosh et al. (1994); Pennisi et al. (2005); Nunu et al. (2019)
Nitrogen-15 of nitrate ($\delta^{15}\text{N}$ of NO_3)	Microbial denitrification; nitrate contamination; anthropogenically derived versus natural sources of nitrate	Zhang et al. (2019); Veale et al. 2019; Jung et al. (2020)
Oxygen-18 of nitrate ($\delta^{18}\text{O}$ of NO_3)	Identification of nitrate sources; used to distinguish precipitation or synthetic nitrate as well as nitrification processes	Ladouche et al. (2001); Zhang et al. (2019);
Sulfur-34 of sulfate ($\delta^{34}\text{S}$ of SO_4)	Applications in sulfur cycle processes and signals in groundwater; signatures of sedimentary sulfide minerals or hydrogen sulfide	Li et al. (2018); Wang & Zhang (2019)
<i>Radiogenic Isotopes</i>		
Carbon-14 (^{14}C) of DIC in water	Radiocarbon dating of groundwater; environmental tracer for groundwater flow directions and rates of recharge	Bhandary et al. (2015)
Tritium (^3H)	Hydrogen isotope used to differentiate between groundwater recharged before, during, or after nuclear activities in the 1950s; environmental age dating tracer	Ridgeway et al. (2005); Nunu et al. (2019)
Strontium-87/86 ($^{87}\text{Sr}/^{86}\text{Sr}$) of dissolved strontium	A radiogenic isotope used as an environmental tracer of dissolved strontium from weathering of geologic settings	Uliana et al. (2007); Nunu et al. (2019)

Baseline analyses will establish a framework to target additional wells and springs for future sampling, discern local and regional sources of recharge, and constrain rock-water interactions that may support conceptualizations and modeling regarding flow paths to each spring.

The geochemical database will be enhanced by conducting two water collection campaigns during the project, one during the first four months of the project and the second early during the second year of the project. Water chemistry data from these sampling campaigns will enrich the geochemical database of the study area already compiled by the project team (Nunu and Green, 2020).

Multivariate statistical analyses (i.e., principal components analysis, exploratory factor analysis, and hierarchical clustering) will be conducted on the geochemical database enhanced by the two additional sampling campaigns. This exercise will be used to differentiate which principal components could be used to fingerprint different source areas and, hence, geochemical endmembers. From these results, hydraulic regimes will be able to be interpreted when well data are compared with spring discharge data.

Mixing and reaction-path model analysis of the geochemical data will provide insight on relative quantities of recharge provided by each source area. Reaction-path modeling will calculate equilibrium chemistry to demonstrate or identify possible pathways from source rocks to springs that produce observed spring chemistry. Mixing models will provide constraints on changes in concentrations along flow paths that may be attributed to the reduction or increase from a particular source area. By having time series data, changes in the relative contributions from each source area will be able to be ascertained. Most importantly, future changes in the hydrochemistry of spring discharge will be able to be used as precursors or indicators of changes in recharge, source area contributions, and quantities due to changes in land use and climate.

Mixing model results will provide the relative amounts of recharge provided by each endmember (i.e., recharge source area). Once the sources for spring discharge are reasonably constrained, the impact of changes in land use (i.e., due to pumping depletion from a source area) or climate (i.e., due to change in precipitation and, hence, recharge) on spring discharge hydrochemistry and rate can be ascertained. Having this basic understanding of the flow regimes that sustain the springs, resource allocation guidance can be developed. This guidance will assist water resource managers to understand how spring discharge could be impacted by future events.

The project team will work with a broad range of stakeholders to disseminate the products generated by the project. Most important, all products developed by the project will be placed in the public domain for access by all stakeholders and interested parties. Two town hall meetings will be offered during the course of the project. Both will be held within the study area to encourage local participation. The first town hall meeting will be held at the end of the first year of the project. Results from the first sampling campaign and early modeling results will be presented at this meeting. The second town hall meeting will be held near the end of the project after preparation of the draft final report. Public and peer review comments will be solicited for incorporation into the final report.



The town hall meetings will be conducted with support of the Environmental Defense Fund and coordinated with the Reeves County and Middle Pecos GCDs.

Describe the work plan for the project. Include an estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates.

The work plan for the project is outlined in Table 3.

Table 3. Major tasks and activities of the proposed project.

Task	Activities	Staffing Team
Historical data collection	Hydrologic data from existing public databases will augment data collected during previous SwRI field campaigns.	<ul style="list-style-type: none"> • SwRI • MPGCD Hydrogeologist A, Hydrogeologist B • RCGCD Hydrogeologist • TNC Freshwater Ecologist
Field data collection	Two field campaigns will be conducted over the course of the project to collect 32 samples from springs and groundwater wells in the study area.	<ul style="list-style-type: none"> • SwRI • MPGCD General Manager • RCGCD General Manager, Field Technician • TNC Freshwater Ecologist
Baseline geochemical and statistical analyses	<p>Hydrochemical concentration contour maps will be developed to understand spatial variations and regional patterns. Piper diagrams and bivariate plots will be employed to categorize springs and wells by hydrochemical assemblages.</p> <p>Application of principal component analysis, exploratory factor analysis, and hierarchical clustering will be used to differentiate important components that can fingerprint different source areas and hydraulic regimes.</p>	<ul style="list-style-type: none"> • SwRI • MPGCD Hydrogeologist A, Hydrogeologist B • RCGCD Hydrogeologist • TNC Freshwater Ecologist
Geochemical and conceptual model development	Mixing and reaction-path models will be developed, which will provide the basis to refine conceptualizations of the complex water regimes in the study area. Input from the GCD hydrogeologists will be incorporated.	<ul style="list-style-type: none"> • SwRI • MPGCD Hydrogeologist A, Hydrogeologist B • RCGCD Hydrogeologist • TNC Freshwater Ecologist



Task	Activities	Staffing Team
Development of resource allocation guidance	Relative amounts of recharge from different source areas and potential changes in spring hydrochemistry will be ascertained. Better conceptualizations of flow regimes will guide recommendations for future groundwater use.	<ul style="list-style-type: none"> • SwRI • MPGCD Hydrogeologist A, Hydrogeologist B • RCGCD Hydrogeologist • TNC Freshwater Ecologist
Stakeholder engagement	The project team will present project findings and results at two town hall meetings. Stakeholders will have the opportunity to provide input and ask questions about the progress and impact of the proposed project.	<ul style="list-style-type: none"> • SwRI • MPGCD General Manager, Hydrogeologist A, Hydrogeologist B • RCGCD General Manager, Hydrogeologist • TNC Freshwater Ecologist
Project management/reporting	Status reports and final presentations will be conveyed to BOR, the two GCDs, and TNC.	<ul style="list-style-type: none"> • SwRI

Major project milestones and estimated dates of completion are outlined in Table 4.

Table 4. Major milestones and estimated dates of completion of the proposed project.

Milestone	Estimated Date
Interim report on water sample collection A	10 months after start
First stakeholder town hall	12 months after start
Interim report on water sample collection B	20 months after start
Draft Final Report	22 months after start
Second stakeholder town hall	23 months after start
Final Report	24 months after start

Provide a summary description of the products that are anticipated to result from the project. These may include data, metadata, digital or electronic products, reports, and publications.

Anticipated products and results from the proposed project as outlined in Table 5.

Table 5. Anticipated products and results from the proposed project.

Anticipated Products	Anticipated Results
<p>Geochemical database of water samples from the study area (including extensive data already compiled by the project team and data from any samples collected and analyzed as part of the proposed project) will be compiled in a geodatabase. Data will include extensive chemical analysis of collected water samples, including major ions, trace metals, and stable and radiogenic isotopes. GIS datasets (e.g., shapefiles, rasters, triangular irregular networks) will include appropriate metadata.</p>	<p>The geodatabase, which will be compatible with industry accepted GIS platforms, will include geochemical observations of key springs and wells to provide the basis for identification of source areas and analysis of temporal changes in flow regimes.</p>
<p>Model files from the development of mixing and reaction-path models predicated on the above described databases will be provided. Models used to calculate quantitative relationships between source areas and points of discharge will be ascertained, to the degree possible, using results from the geochemical geodatabase and model interpretations.</p>	<p>Flow regimes will be conceptualized using the geochemical geodatabase and model results in conjunction with geological structural frameworks, hydrologic data, and other relevant data and information.</p>
<p>Maps and visualizations of source areas will be created. Source areas for springs and flow regimes will be identified, to the degree possible, using results from database and model interpretations.</p>	<p>Temporal variations in water chemistry will be identified by time series analysis of the compiled and robust geochemical data.</p>
<p>A final report that summarizes project findings and recommendations for water resource allocation will be made publically available.</p>	<p>Changes in spring discharge chemistry due to potential (i.e., speculated) changes in climate (i.e., recharge rates at select source areas) or land use (i.e., pumping at select locations) will be calculated using the mixing and reaction path models developed for current conditions.</p>

Identify staff with appropriate credentials and experience and describe their qualifications. Describe the process and criteria that will be used to select appropriate staff members for any positions that have not yet been filled. Describe any plans to request additional technical assistance from Reclamation or via a contract. Please answer the following.

Ms. Nunu is a groundwater hydrologist with experience and interests in karst hydrogeology, aqueous geochemistry, regional surface-water and groundwater flow

systems, and surface-water/groundwater interactions. As a Scientist at Southwest Research Institute, she quantifies water resources using geochemical indicators and geographic information systems in order to provide refined conceptualizations of hydrologic systems. Ms. Nunu's recent work focuses on characterization of aquifer recharge-discharge relations using geochemical indicators and multivariate statistical analyses with particular interest in arid and semi-arid environments.

Dr. Wittmeyer is a hydrologist with expertise in developing and applying computational methods to assess the fate and transport of contaminants in the subsurface environment, performing hydrologic inverse modeling, conducting environmental risk assessments using probabilistic methods, and developing practical methods for grid-scale energy storage. He has extensive experience assembling and leading multidisciplinary teams of scientists and engineers to solve complex engineering and environmental problems. As a Senior Scientist, Dr. Wittmeyer is responsible for identifying new technologies and markets that will sustain the viability of the Center for Nuclear Regulatory Analyses (CNWRA®) and enhance the technical expertise and utilization of its staff. Dr. Wittmeyer recently proposed constructing closed-loop pumped storage hydropower units in west Texas that use excess production brine from oil and gas operations in the Permian Basin to fill the upper and lower reservoirs, and, as a result, is familiar with the hydrology of the study area.

Dr. Green has over 40 years of experience in water resource investigations with the most recent 25 years focusing on the water resources of arid and semi-arid environments including central and west Texas. These investigations incorporated a range of field data acquisition campaigns that included geophysical surveys, gain-loss surveys, hydrological assessments, water chemistry analyses, and geological structural studies to support development of conceptual and analytical models of complex surface-water/groundwater regimes. Dr. Green is a registered geoscientist in Texas.

Have the project team members accomplished projects similar in scope to the proposed project in the past either as a lead or team member?

The project team has conducted extensive investigations of the water resources of Pecos and adjoining counties for the past decade. In addition, the fundamental focus of this previous work has been the development of conceptual models and water-budget analyses for sub-domains within the greater Edwards Plateau area. Following is a listing of notable projects with descriptions.

- San Solomon Springs System Analysis. The project team has been evaluating the water resources of the springs at San Solomon for three years (Nunu et al., 2017; Nunu and Green, 2020; Nunu, 2020). These studies include springs in Reeves, Jeff Davis, and Pecos counties. The evaluation is predicated on robust sampling and analysis of the chemistries of the water discharged at these springs supplemented by comparable sampling and analysis of groundwater from wells located in the purported source areas of the targeted springs.
- Devils River Watershed Assessment and Model. The project team has conducted several studies focused on the Devils River watershed over the past decade. The



hydrogeology of the watershed was characterized using water chemistry, geophysical imaging of the subsurface, aquifer hydraulics, recharge evaluations, and water budget analyses (Green et al., 2014, 2019). Numerical models were developed to replicate the hydraulics of the conceptual model (Fratesi et al., 2015; Toll et al., 2017).

- Western Edwards-Trinity Aquifer Evaluation. In 2010, the project team conducted an evaluation of the water resources of eight counties (i.e., Crockett, Edwards, Kimble, Menard, Real, Schleicher, Sutton, and Val Verde) that rely on the Edwards-Trinity Aquifer for their water resources. Estimates of recharge rates versus precipitation rates and the water budgets were provided by this evaluation (Green and Bertetti, 2010; Green et al., 2012).
- Edwards-Trinity Aquifer Epikarst Evaluation. Based upon the results of the 2010 Western Edwards-Trinity Aquifer Evaluation, the project team conducted focused studies on the nature of recharge and groundwater flow in the Edwards-Trinity Aquifer (Green et al., 2015). Subsequent water resource evaluations and watershed models were predicated on the findings of the epikarst study (Fratesi et al., 2015; Toll et al., 2017).

Is the project team capable of proceeding with tasks within the proposed project immediately upon entering into a financial assistance agreement? If not, please explain the reason for any anticipated delay

Yes, the project team can immediately proceed with tasks within the proposed project upon entering into a financial assistance agreement.

Evaluation Criterion D – Dissemination of Results

Describe how the tools, frameworks, or analyses being developed will be disseminated, communicated, or made available to water resources managers who may be interested in the results.

Middle Pecos GCD and Reeves County GCD will contribute in-kind support to provide stakeholder engagement with water resource managers and residents in the study area. Both districts have agreed to help organize two town hall meetings, one during each year of the project, to allow the project team to share their results and get feedback from the community. Such involvement will provide stakeholders with tools to make decisions that will protect and maintain the viability of their water resources.

If the applicant is the primary beneficiary of the project, explain how the project results will be communicated internally, and to interested stakeholders and interested water resources managers in the area, if appropriate.

The applicant is not the primary beneficiary of the project.

If the applicant is not the primary beneficiary of the project (e.g., universities or research institutes), describe how project results will be communicated to project partners and interested water resources managers in the area.

The project will conduct two town hall meetings in the communities within the study area. All stakeholders will be invited. One town hall meeting will be conducted at the end of the first year of the project. The second town hall meeting will be held at the conclusion of the project at a time when the penultimate final report is available. Environmental Defense Fund has offered to help facilitate the town hall meetings.

Status reports and final presentations will be conveyed to the two GCDs supporting the project. Feedback and input from the GCDs and other stakeholders will be solicited during these interactions.

The project team will publish a final report that will be publically available. This will allow for broad peer review. The report will be posted on a publically available website sponsored by one of the stakeholders.



Environmental and cultural resources compliance

Will the proposed project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.

The proposed project will extract small volumes of water from aquifers in the study area during geochemical sample collection. Standard protocols require purging a well of at least three casing volumes to accurately assess water quality properties. However, the stress imposed on the aquifers is brief and water level recovery resumes once the well is no longer being purged. The time of water level recovery can range from minutes to a couple of hours. No additional disturbances of air, water, or animal habitat will occur during the course of this project.

Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?

The springs provide habitats for rare and endemic species found in San Solomon, Phantom Lake, and East Sandia Springs. Federally endangered species that depend on these spring habitats include the Comanche Springs pupfish and Pecos gambusia (TPWD, 2018). These rare and endemic species would be not affected by sample collection efforts associated with the proposed project.

Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as “Waters of the United States?” If so, please describe and estimate any impacts the proposed project may have.

No surface waters or wetlands will be impacted by the proposed project.

When was the water delivery system constructed?

Private water wells and conveyance infrastructure to be used in the course of this project were constructed beginning in the early 1900s.

Will the proposed project result in any modification of or effects to, individual features of an irrigation system (e.g., headgates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously.

No.



Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? A cultural resources specialist at your local Reclamation office or the State Historic Preservation Office can assist in answering this question.

No.

Are there any known archeological sites in the proposed project area?

No archeological sites will be impacted because the project does not involve any land clearing or construction activities.

Will the proposed project have a disproportionately high and adverse effect on low income or minority populations?

No.

Will the proposed project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?

No.

Will the proposed project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area?

No.



Required permits or approvals

Permits are required from the following entities to sample springs in the study area:

- The Nature Conservancy: East Sandia Spring, Diamond Y Spring, Euphrasia Spring
- Texas Parks and Wildlife Department: San Solomon Spring
- Bureau of Reclamation: Phantom Lake Spring

SwRI has worked closely with The Nature Conservancy and Texas Parks and Wildlife to secure required permits for spring samples for recent projects. The project team expects that these permits will be approved by each entity in the proposed project.

Phantom Lake Spring, one of the major springs of the San Solomon Springs system, is owned by the BOR. The project team hopes to work with the BOR to obtain required permits to collect samples for analysis.



Project Budget

Funding plan

Sources of non-Federal cost share contribution for the project includes:

- \$100,000 support contributed by the Horizon Foundation.
- \$50,000 (\$20,000 support and \$30,000 of in-kind costs) contributed by Middle Pecos Groundwater Conservation District for data integration and geologic model development for Diamond Y and Euphrasia springs, coordination of site access to springs and wells in the study area, and the coordination of town hall meetings to allow the project team to share results with the community.
- \$30,000 of in-kind costs contributed by Reeves County Groundwater Conservation District for data integration and water resource evaluation of Reeves County, coordination of site access to springs and wells in the study area, and the coordination of town hall meetings to allow the project team to share results with the community.
- \$20,000 in-kind support from The Nature Conservancy to provide input into the databases necessary for extending the tools across the expanded study area. TNC will also provide feedback to ensure that the project outcomes are fully integrated into the needs of the community and stakeholders.

Letters of Support are enclosed in this proposal under “Letters of Funding Commitment.”

Budget proposal

The total project cost is the sum of voluntary committed cost sharing, which includes third-party contributions (Table 6). The itemized budget proposal is outlined in Table 7.

Table 6. Total Project Cost Table.

SOURCE	AMOUNT
Costs to be reimbursed with the requested Federal funding	\$200,000
Costs to be paid by the applicant	\$120,000
Value of third-party contributions	\$80,000
TOTAL PROJECT COST	\$400,000



Table 7. Itemized Budget Proposal.

BUDGET ITEM DESCRIPTION	COMPUTATION		Quantity Type	Total Cost (\$)
	Rate (\$)	Quantity		
SALARIES AND WAGES: YEAR 1				
R. Nunu, Scientist	27.63	428	Hours	11,826
G. Wittmeyer, Principal Scientist	98.72	143	Hours	14,117
			Fringe Burden (49.00%)	12,712
			Overhead (97.05%)	37,514
			G&A (48.09%)	18,284
			COFC (1.53%)	599
SALARIES AND WAGES: YEAR 2				
Rebecca Nunu, Scientist	28.49	363	Hours	10,331
G. Wittmeyer, Principal Scientist	101.69	138	Hours	14,135
			Fringe Burden (49.00%)	11,988
			Overhead (96.67%)	35,241
			G&A (48.09%)	17,532
			COFC (1.53%)	559
TRAVEL				
Travel, Domestic	2,508	2	Trip	5,016
CONTRACTUAL				
Ronald Green, Consultant Year 1	110	177.5	Hours	19,525
Ronald Green, Consultant Year 2	110	177.5	Hours	19,525
LCRA-ELS	2,297	32	Samples	73,504
Tetra Tech	325	32	Samples	10,400
University of Pittsburg	115	32	Samples	3,680
			Material Handling Burden Year 1 (4.35%)	2,284
			Material Handling Burden Year 2 (4.46%)	1,228
THIRD-PARTY IN-KIND CONTRIBUTIONS				
Middle Pecos Groundwater Conservation District				
SALARIES AND WAGES: YEAR 1				
Hydrogeologist A	140	100	Hours	14,000
Hydrogeologist B	110	100	Hours	11,000
General Manager	37	48	Hours	1,782
Field Technician	19	36	Hours	684
SALARIES AND WAGES: YEAR 2				
General Manager	37	50	Hours	1,850
Field Technician	19	36	Hours	684
Reeves County Groundwater Conservation District				
SALARIES AND WAGES: YEAR 1				
Hydrogeologist	230	50	Hours	11,500
General Manager/staff	75	47	Hours	3,500
SALARIES AND WAGES: YEAR 2				
Hydrogeologist	230	50	Hours	11,500
General Manager	75	47	Hours	3,500
The Nature Conservancy				
SALARIES AND WAGES: YEAR 1				
Freshwater Ecologist	64	156.25	Hours	10,000



BUDGET ITEM DESCRIPTION	COMPUTATION		Quantity Type	Total Cost (\$)
	Rate (\$)	Quantity		
SALARIES AND WAGES: YEAR 2				
Freshwater Ecologist	64	156.25	Hours	10,000
TOTAL:				400,000

Budget narrative

The budget has been developed with the assumption that the project would be announced late summer 2021 and would begin late spring 2022.

Salaries and Wages

Salaries and wages includes the project manager and principal investigator, Rebecca Nunu, Scientist at SwRI. Other personnel includes Gordon Wittmeyer, Senior Scientist and Ronald Green, Consultant at SwRI. Please see itemized budget in Table 7 for salaries and wages, estimated hours, and compensation rates.

Fringe Benefits

The “Established Fringe Burden Rate for Bidding and Billing Purposes Dated September 8th, 2020” letter (included in the proposal submission) covers fringe benefits.

Travel

Travel expenses are outlined in Table 8 and have been calculated using per diem rates as set forth by the General Services Administration for Balmorea, Texas in Reeves County.



Table 8. Travel expenses for the proposed Applied Science Grant.

Trip 1, Year 1	
Purpose of anticipated trip	The first trip will include the sampling of 8 springs and 8 wells in the study area.
Destination	Culberson, Jeff Davis, Reeves, and Pecos counties.
Number of persons traveling	Two: Ms. Nunu and Dr. Green will participate in the field campaign.
Length of stay	The first trip will be five days long.
Travel cost:	
Vehicle	\$675 for one premium SUV for field equipment for five days (\$135/day).
Per diem*	\$660 (two staff, five days - \$66/day).
Lodging	\$1340 (two staff, five days - \$134/day).
Miscellaneous travel expenses	\$154. This includes expenses for supplies in the field (e.g., ice for sample preservation) and gas for the rental vehicle.
Trip 2, Year 2	
Purpose of anticipated trip	The first trip will include the sampling of the same 8 springs but 8 different wells in the study area.
Destination	Culberson, Jeff Davis, Reeves, and Pecos counties.
Number of persons traveling	Two: Ms. Nunu and Dr. Green will participate in the field campaign.
Length of stay	The second trip will be five days long.
Travel cost:	
Vehicle	\$675 for one premium SUV for field equipment for five days (\$135/day).
Per diem*	\$660 (two staff, five days - \$66/day).
Lodging	\$1340 (two staff, five days - \$134/day).
Miscellaneous travel expenses	\$154. This includes expenses for supplies in the field (e.g., ice for sample preservation) and gas for the rental vehicle.

*Total cost does not reflect that only part of the full per diem rate is allowed for the first and last day of travelling. However, this adjustment is reflected in Table 7 under "Travel Expenses" header.

Equipment

SwRI owns all necessary equipment needed for the project, so equipment will not be purchased or rented.

Materials and Supplies

With the exception of $\delta^{11}\text{B}$ and $\delta^{15}\text{N}$, $\delta^{18}\text{O}$, and $\Delta^{17}\text{O}$ of nitrate in water, all samples will be sent to LCRA-ELS for analysis. The cost per analysis for the geochemical constituent(s) is provided in Table 9. These prices are provided from quotes previously received from each laboratory in early 2021.

Table 9. Recommended geochemical constituents to collect from wells and springs in the study area. Contract laboratories denoted by an asterisk (*) are subcontracted by Lower Colorado River Authority Environmental Laboratory Services.

Geochemical Constituent	Contract Laboratory	Cost per analysis
Cations, anions, trace metals, alkalinity, nutrients	Lower Colorado River Authority Environmental Laboratory Services (Austin, TX)	\$400
$\delta^2\text{H}$, $\delta^{18}\text{O}$, $\delta^{13}\text{C}$, ^{14}C in water		\$744
^3H in water		\$437
$^{87}\text{Sr}/^{86}\text{Sr}$ in water		\$281
$\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ of sulfate in water		\$435
Boron-11 ($\delta^{11}\text{B}$) in water	Tetra Tech (Fort Collins, CO)	\$325
$\delta^{15}\text{N}$, $\delta^{18}\text{O}$, and $\Delta^{17}\text{O}$ of nitrate in water	University of Pittsburg (Pittsburg, PA)	\$115
		TOTAL: \$2,737

Contractual

Consultants and contractors will help to accomplish project objectives and tasks. Dr. Ronald Green, a recent retiree of SwRI, has been active in water resource analyses of the Edwards-Trinity Aquifer and adjoining areas for the past two decades. He currently provides on-going support as a consultant to numerous SwRI projects. Dr. Green will provide technical support for the following tasks:

Table 10. Tasks for which Dr. Green (consultant) will provide technical support).

TASK	Description	Number of Hours	Cost
Task 2: Field data collection	Assistance in collecting samples from wells and springs.	80	\$8800
Task 3: Baseline geochemical and statistical analyses	Technical guidance and support for conducting analyses.	43	\$4730
Task 4: Geochemical and conceptual model development	Technical guidance and support for model development.	96	\$10560
Task 5: Development of resource allocation guidance	Technical guidance and support in the application of conceptual model in resource allocation guidance.	96	\$10560
Task 6: Stakeholder engagement	Assistance in presenting project results to the community.	24	\$2640
Task 7: Project Management/Reporting	Assistance in reporting technical results.	16	\$1760
TOTAL:		355	\$39,050

Lower Colorado River Authority Environmental Lab Services (LCRA-ELS) in Austin, Texas is a contractor SwRI has utilized for the last 3 years for geochemical analyses. They have consistently provided reliable, high quality, and robust analyses of groundwater samples for a reasonable cost.

Tetra Tech in Fort Collins, Colorado is contractor SwRI has utilized for the last 3 years for geochemical analyses. They have consistently provided reliable, high quality, and robust analyses of $\delta^{11}\text{B}$ in groundwater samples for a reasonable cost.

University of Pittsburg in Pittsburg, Pennsylvania has been contracted and recommended by our collaborators at the University of Texas at San Antonio. Labs that conduct analyses of $\delta^{15}\text{N}$, $\delta^{18}\text{O}$, and $\Delta^{17}\text{O}$ of nitrate are limited. University of Pittsburg also provides a competitive analytical cost for these samples.

Third-Party In-Kind Contributions

Middle Pecos GCD will contribute \$30,000 of in-kind support for coordinating site access to springs and wells in the study area and providing input as the project progresses. Middle Pecos GCD has been awarded \$32,000 from The Nature Conservancy to refine a geologic model for the Diamond Y and Euphrasia Spring System, one of the iconic spring systems that will be studied in the proposed project. The District will provide \$25,000 of in-kind contributions from this project to the proposed Applied Science Grant. In-kind contributions will also include paid labor in the form of coordinating site access to springs and wells in the study area, providing input as the project progresses, and coordinating town hall meetings over the course of the project that will allow the project team to present their findings to the community.

Reeves County GCD will contribute \$30,000 of in-kind support. Hydrogeologists at Advanced Groundwater Solutions, LLC, a consulting firm retained by Reeves County GCD, will provide in-kind support in the form of time devoted by the consultants to support execution of the proposed project. In-kind contributions will also include paid labor from the General Manager in the form of coordinating site access to springs and wells in the study area, providing input as the project progresses, and coordinating town hall meetings over the course of the project that will allow the project team to present their findings to the community.

The Nature Conservancy will contribute \$20,000 of in-kind support. TNC will provide input into the databases necessary for extending the tools across the expanded study area. TNC will provide realtime feedback during the conduct of the Applied Science project to insure that the project outcomes are fully integrated into the needs of the community and stakeholders.

Other Expenses

Other expenses are not anticipated for the project.

Indirect Costs

The forward pricing rate request letter (included in the proposal submission) covers indirect costs.



Letters of Funding Commitment

Letters of Funding Commitment are provided by the following collaborators:

- Ty Edwards, General Manager of Middle Pecos GCD
- Greg Perrin, General Manager of Reeves County GCD
- Rod Sanders, President of the Horizon Foundation
- Ryan Smith, Freshwater Ecologist of The Nature Conservancy



Letters of Support

In addition to the Letters of Funding Commitment, a number of stakeholders have also provided Letters of Support of the proposed project, including:

- John Davis, Mayor of Balmorhea
- Craig Huelster, General Manager of Madera Valley Water Supply Corporation
- Robert Mace, Executive Director and Chief Water Policy Officer at The Meadows Center for Water and the Environment
- Vanessa Puig-Williams, Director of Texas Water Program of Environmental Defense Fund



References

- Bao, H., Coa, X., and Hayles, J.A. (2016). Triple Oxygen Isotopes: Fundamental Relationships and Applications: Annual Review of Earth and Planetary Sciences, v. 44, p. 463-492, <https://doi.org/10.1146/annurev-earth-060115-012340>.
- Bethke, C.M. (2008). Geochemical and Biogeochemical Reaction Modeling. Cambridge University Press, New York, 547 pp.
- Bethke, C.M., Farrell, B., and Sharifi, M. (2020). The Geochemist's Workbench® User's Guides, Release 14.0. Aqueous Solutions LLC, Champaign.
- Bhandary, H., Al-Senafy, M., and Marzouk, F. (2015). Usage of Carbon Isotopes in Characterizing Groundwater Age, Flow Direction, Flow Velocity and Recharge Area. Procedia Environmental Sciences, v. 25, p. 28-35. <https://doi.org/10.1016/j.proenv.2015.04.005>
- Craig, H. (1961). Isotopic Variations in Meteoric Waters: Science, v. 133, p. 1702-1703. <https://doi.org/10.1126/science.133.3465.1702>
- Fratesi, S.E., R.T. Green, F.P. Bertetti, R.N. McGinnis, N. Toll, H. Başağaoğlu, L. Gergen, J. Winterle, Y. Cabeza, and J. Carrera. (2015). Development of a finite-element method groundwater flow model of the Edwards Aquifer: Final Report. Southwest Research Institute. Conducted for the Edwards Aquifer Authority. 180 p.
- Green, R.T. and F.P. Bertetti. (2010). Investigating the Water Resources of the Western Edwards-Trinity Aquifer. Contract Report Prepared for the Sutton County Groundwater Conservation District. 79 p.
- Green, R., F. Bertetti, and M. Hernandez. 2012. Recharge Variability In Semi-Arid climates. *Nature Education Knowledge* 3(10):34. <http://www.nature.com/scitable/knowledge/library/recharge-variability-in-semi-arid-climates-26169682>
- Green, R.T., N. Toll, and F.P. Bertetti. (2015). Sustainable Yield of a Carbonate Aquifer Dominated by Preferential Flow: Devils River Watershed, South Texas, USA. Final Report. Contract Report for the Nueces River Authority.
- Green, R.T., F.P. Bertetti, and M.S. Miller. (2014). Focused Groundwater Flow in a Carbonate Aquifer in a Semi-Arid Environment. *Journal of Hydrology*. 517:284–297. doi: 10.1016/j.jhydrol.2014.05.015



Green, R.T., S.E. Fratesi, N. Toll, F.P. Bertetti, R. Nunu. (2019). Devils River Watershed., in Sharp, J.M., Jr., Green, R.T., and Schindel, G.M., eds., *The Edwards Aquifer: The Past, Present, and Future of a Vital Water Resource: Geological Society of America Memoir 215*, p. 101–118, [https://doi.org/10.1130/2019.1215\(08\)](https://doi.org/10.1130/2019.1215(08)).

Jung, H., Koh, D.C., Kim, Y.S., Jenn, S.W., and Lee, J. (2020). Stable Isotopes of Water and Nitrate for the Identification of Groundwater Flowpaths: A Review: *water*, v. 12, 19 p., <https://doi.org/10.3390/w12010138>. Knierim, K.J., Pollock, E., and Hays, P.D. (2013). Using isotopes of dissolved inorganic carbon species and water to separate sources of recharge in a cave spring, Northwestern Arkansas, USA. *Acta Carsologica*, v. 42, p. 261-276. <https://doi.org/10.3986/ac.v42i2-3.667>

Ladouche, B., Probst, A., Viville, D., Idir, S., Baqué, D., Boubet, M., Probst, J.-L., and Bariac, T. (2001). Hydrograph separation using isotopic, chemical and hydrological approaches (Strengbach catchment, France): *Journal of Hydrology*, v. 242, p. 255-274, [https://doi.org/10.1016/S0022-1694\(00\)00391-7](https://doi.org/10.1016/S0022-1694(00)00391-7).

Li, X., Wu, P., Han, Z., Zha, X., Ye, H., and Qin, Y. (2018). Effects of mining activities on evolution of water quality of karst waters in Midwestern Guizhou, China: evidences from hydrochemistry and isotopic composition: *Environmental Science and Pollution Research*, v. 25, p. 1220-1230, <https://doi.org/10.1007/s11356-017-0488-y>. Nunu et al., 2017

Nunu, R.R., Green, R.T., Fratesi, B., and Martin, N. (2019). Using Geochemical Analyses to Discern Source Areas of Multi-Outlet Spring Systems: Southwest Research Institute Targeted IR&D Project 15-R8981, 21 p.

Nunu, R.R., and Green, R.T. (2020). Hydrologic Conceptualization of San Solomon Springs in the Lower Delaware Basin: Phase III Status Report for Big Bend Conservation Alliance, 51 p.

Pennisi, M., Gonfiantini, R., Grassi, S., and Squarci, P. (2006). The utilization of boron and strontium isotopes for the assessment of boron contamination of the Cecina River alluvial aquifer (central-western Tuscany, Italy). *Applied Geochemistry*, v. 21, p. 643-655. <https://doi.org/10.1016/j.apgeochem.2005.11.005>

Ridgeway C, Austin B, Boghici R, Chowdhury A, Christian B, Coker D, Mace R, Mathews R, Schuster S, Smith R, and Watson W. (2005). Diminished spring flows in the San Solomon Springs System, Trans-Pecos, Texas. Texas Parks and Wildlife Report 84312 [unpublished]. https://tpwd.texas.gov/business/grants/wildlife/section6/docs/habitats/e19_final_report.pdf.

Surma, J., Assonov, S., Bolourchi, M.J., and Staubwasser, M. (2015). Triple oxygen isotope signatures in evaporated water bodies from the Sistan Oasis, Iran: *Geophysical Research Letters*, v. 42, p.8456-8462, <https://doi.org/10.1002/2015GL066475>.

Toll, N., S.B. Fratesi, R.T. Green, F.P. Bertetti, and R. Nunu. (2017). *Water-Resource Management of the Devils River Watershed Final Report*. Contract Report for the Devils River Conservancy.

Texas Parks and Wildlife Department (2018). *San Solomon Springs Biomonitoring Plan*. Texas Parks and Wildlife, Austin, Texas, 92 p.

Uliana, M.M., Banner, J.L., and Sharp Jr., J.M. (2007). Regional groundwater flow paths in Trans-Pecos, Texas inferred from oxygen, hydrogen, and strontium isotopes. *Journal of Hydrology*, v. 334, p. 334-346, <https://doi.org/10.1016/j.jhydrol.2006.10.015>.

Veale, N., Visser, A., Esser, B., Singleton, M.J., and Moran, J.E. (2019). Nitrogen Cycle Dynamics Revealed Through $\delta^{18}\text{O}\text{-NO}_3$ – Analysis on California Groundwater. *Geosciences*, v. 9, 15 p. <https://doi.org/10.3390/geosciences9020095>

Vengosh, A., Heumann, K.G., Juraske, S., Kasher, R. (1994). Boron Isotope Application for Tracing Sources of Contamination in Groundwater. *Environmental Science & Technology*, v.28, p. 1968-1974. <https://doi.org/10.1021/es00060a030>

Wang, H., and Zhang, Q. (2019). Research Advances in Identifying Sulfate Contamination Sources of Water Environment by Using Stable Isotopes: *International Journal of Environmental Research and Public Health*, v. 16, 13 p, <https://doi.org/10.3390/ijerph16111914>

Zhang, Y., Shi, P., Song, J., and Li, Q. (2019). Application of Nitrogen and Oxygen Isotopes for Source and Fate Identification of Nitrate Pollution in Surface Water. A Review, *Applied Science*, v. 9, 18 p. <https://doi.org/10.3390/app9010018>



A Cost Proposal for

APPLICATION OF A GEOCHEMICAL TOOL FOR WATER RESOURCE MANAGEMENT IN A SEMI-ARID LANDSCAPE: TRANS PECOS, TEXAS USA

Solicitation Number R21AS00289

SwRI® Proposal Number 15-91667

April 21, 2021

Prepared for:

Bureau of Reclamation

Prepared by:

Southwest Research Institute®

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San Antonio, Texas 78238-5166

Sr. Specialist: Bryce DeWispelare, (210) 522-5815

Southwest Research Institute (SwRI) is a large nonprofit corporation organized in the public interest and existing under the laws of the State of Texas, with its general offices and laboratories located at 6220 Culebra Road, San Antonio, Texas, 78238. Additional off-site offices and laboratories are located in several other cities within the United States. For over 25 years, to meet the needs of our sponsors and clients SwRI has employed between 2400 and 3100 full-time staff members performing or supporting Research, Development and Testing Initiatives across the world.

The data furnished in this proposal shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed in whole or in part for any purpose other than to evaluate this proposal and as may be further permitted in this proposal; provided, that if an award is made to this offeror as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the award. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in the Cost Section, in its entirety.

Southwest Research Institute

SwRI Proposal No. 15-91667

Solicitation No. R21AS00289

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Southwest Research Institute
GOVERNMENT GRANT PROPOSAL
TERMS AND CONDITIONS

SwRI Proposal No. 15-91667
Solicitation No. R21AS00289

Cost and Pricing Data

It is desired that a grant be provided, with cost determination in accordance with the appropriate Procurement Regulations. The total estimated cost to perform the proposed program is \$400,000, less cost sharing of \$200,000. The total funds requested are \$200,000. Variances in Attachment A, if any, are due to rounding by pricing software.

Labor hour allocations are engineering estimates based upon a detailed evaluation of program requirements. In consultation with key technical personnel to be assigned responsibility for accomplishment of this project, engineering estimates of labor hours required were obtained. The labor hours thereby identified with specific skill levels were then grouped into appropriate labor classifications as shown on Attachment A.

The labor rates used in the cost estimate are weighted average rates for each labor category based on utilization. An allowance may be included for annual salary increase based on current experience. The annual salary increases are based upon a review of current and anticipated future economic conditions.

Prices for Subcontractor(s) are engineering estimates and/or established from quotations (verbal or written), Subcontractor price sheets and/or past subcontracts on file in our Purchasing Department. The supporting documentation for the Subcontractor(s) estimates is maintained in the Operating Division.

Travel expenses are proposed based on anticipated cost of lodging, tips, meals, and other subsistence expenses, subject to per diem limitations established by the U. S. General Services Administration.

SwRI's indirect rates are based on our Forward Pricing Rate Proposal (FPRP) for the fiscal years 2021 through 2026 which were submitted to DCMA on 26 February 2021. A copy of the FPRP is available upon request.

Contractual Information

SwRI has been awarded and is currently performing work under multiple GSA Schedules. Detailed information, including descriptions of the schedules, rates and points of contact, is available at <http://www.swri.org/7biz/GSA/default.htm>.

As a non-profit research and development organization, SwRI will acquire, use, manage and dispose of property under the award in accordance with 2 CFR§200.313.

It is requested that 2 CFR 200.315(c) be included in any resulting award since SwRI is recognized as a nonprofit research and development organization as defined in FAR 27.301.

Intended place of performance is Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas.

This proposal shall remain in effect no longer than one hundred eighty (180) days from date of submission. This proposal constitutes an offer and, if accepted by a Notice of Award to SwRI, will form a binding award on the terms covered by this proposal. It is agreed that any such Notice of Award will be followed by a formal award bearing the same date as the Notice of Award and containing the details of the definitive agreement between the parties.

Any resulting award should include the applicable Catalog of Federal Domestic Assistance (CFDA) number.

Personnel for any contractual negotiations required on this procurement may be contacted as follows:

Mr. Bryce DeWispelare, Senior Specialist, Contracts Department, 210/522-5815, facsimile 210/522-3559, bryce.dewispelare@swri.org;

Mrs. Vera Elizondo, Manager, Contracts Department, 210/522-3949, facsimile 210/522-3559, email vera.elizondo@swri.org;

Ms. Heather M. Bates, Assistant Director, Contracts Department, 210/522-6572, facsimile 210/522-3559, email heather.bates@swri.org;

Mr. W. Troy Nagy, Director, Contracts Department, 210/522-2230, facsimile 210/522-3559, email troy.nagy@swri.org.

Electronic notification of award should be sent to email address contract@swri.org.

It is requested that the following be included in the award: "Either party may execute the contract and any additional documents including, but not limited to, modifications, and representations and certifications related to the award by facsimile or electronic signature. The other party shall be entitled to rely on such facsimile or electronic signature as evidence that the award has been duly executed by an authorized representative. Further, neither party shall contest the validity of the award based on the use of facsimile or electronic signatures."

The Defense Contract Management Agency, DCMA NASA Product Operations, North Beach Pavilion, 2710 Howitzer Street, Bldg. 2372, Fort Sam Houston, Texas, 78234 has responsibility for administration of Department of Defense and some other Governmental agency contracts awarded to SwRI. The Defense Contract Audit Agency (DCAA), Southwest Research Institute Office, 6220 Culebra Road, San Antonio, Texas, 78238 (210/522-2248) is the cognizant Government audit agency for most Government contracts awarded to SwRI.

SwRI is categorized as a non-profit company pursuant to §501(c)(3) of the Internal Revenue Code, but is specified in OMB Circular A-122, Attachment C as exempt from the cost guidelines applicable to non-profit organizations; thus, SwRI is subject to the cost principles applicable to commercial concerns. (See Appendix VIII to 2 CFR Part 200.)

As a non-profit company pursuant to §501(c)(3) of the Internal Revenue Code, SwRI's financial information is publicly available. SwRI's most recent annual audited financial statements, including the corresponding reports on internal control over financial reporting, were included in our comprehensive Office of Management and Budget (OMB) single audit report in accordance with 2 CFR Part 200, Subpart F. The results of this federally required annual audit, including the corresponding report on internal control over compliance, are publicly available at the Federal Audit Clearinghouse <https://harvester.census.gov/facweb>.

SwRI is subject to Cost Accounting Standards and has a Disclosure Statement. Our most recent Disclosure Statement update (Revision 9) has been approved by DCMA and SwRI is in compliance with the cost principles of 2 CFR Part 200, Subpart E.

Payment

It is requested that the clause entitled "Payment" [(2 CFR §200.305(b))] be included in any resulting award.

The preferred method of payment is by electronic funds transfer to the account of Southwest Research Institute.

- Financial Institution: Bank of America, N.A.
- Account Number: 001390004879
- ACH ABA Routing Number: 111000025
- Wire ABA Routing Number: 026009593

Please reference the applicable invoice number with the payment or provide remittance information by email to remit@swri.org.

Covenant Against Contingent Fees

SwRI warrants that no person or agency has been employed or retained to solicit or obtain this award upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this award without liability or, in its discretion, to deduct from the award price or consideration, or otherwise recover, the full amount of the contingent fee. (For interpretation of this covenant, including the terms "bona fide employee or agency," "contingent fee," and "improper influence," see FAR Subpart 3.4 – Contingent Fees.)

SOUTHWEST RESEARCH INSTITUTE

By: 

Name: W. Troy Nagy

Title: Director, Contracts

Date: April 21, 2021

SwRI Proposal No. 15-91667

Attachment A
COST BREAKDOWN

PROPOSAL NUMBER 15-91667

Budget Period: Budget Period 1 **Start** **5/2/22** **End** **5/1/23**

Labor Category	Hrs/Units	Rates	Cost
Principal Investigator/Project Manager: R. Nunu	428.00	27.63	11,826
Co-Investigator 1: G. Whittmeyer	143.00	98.72	14,117
Subtotal Hours/Labor Cost	571.00		25,943
		Fringe Burden 49.00%	12,712
		<i>Subtotal Direct Labor</i>	<u>38,654</u>
		Overhead 97.05%	37,514
		G&A 47.30%	18,284
		COFC 1.551%	599
		<i>Subtotal Labor Costs</i>	<u>95,052</u>
Material Costs:			
Equipment			0
Materials and Supplies			0
Subcontracting			52,466
Freight In			0
		<i>Subtotal Materials & Subcontracting</i>	<u>52,466</u>
		Mat Handling Burden 4.35%	2,284
		<i>Subtotal Materials & Subcontracting & MHB</i>	<u>54,750</u>
Other Direct Costs			
Travel, Domestic			2,508
Travel, Foreign			0
Freight Out			0
Consultants			19,525
Services			43,792
Report Services			0
Photography			0
Communications			0
Other			0
		<i>Subtotal Other Direct Costs</i>	<u>65,825</u>
		Total Estimated Cost	<u>215,627</u>

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PROPOSAL NUMBER 15-91667

Budget Period: Budget Period 2 **Start** **5/2/23** **End** **5/1/24**

Labor Category	Hrs/Units	Rates	Cost
Principal Investigator/Project Manager: R. Nunu	363.00	28.46	10,331
Co-Investigator 1: G. Whittmeyer	139.00	101.69	14,135
Subtotal Hours/Labor Cost	502.00		24,466
		Fringe Burden 49.00%	11,988
		<i>Subtotal Direct Labor</i>	<u>36,454</u>
		Overhead 96.67%	35,241
		G&A 48.09%	17,532
		COFC 1.532%	559
		<i>Subtotal Labor Costs</i>	<u>89,786</u>
Material Costs:			
Equipment			0
Materials and Supplies			0
Subcontracting			27,534
Freight In			0
		<i>Subtotal Materials & Subcontracting</i>	<u>27,534</u>
		Mat Handling Burden 4.46%	1,228
		<i>Subtotal Materials & Subcontracting & MHB</i>	<u>28,762</u>
Other Direct Costs			
Travel, Domestic			2,508
Travel, Foreign			0
Freight Out			0
Consultants			19,525
Services			43,792
Report Services			0
Photography			0
Communications			0
Other			0
		<i>Subtotal Other Direct Costs</i>	<u>65,825</u>
		Total Estimated Cost	<u>184,373</u>
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PROPOSAL NUMBER 15-91667

Budget Period: ALL

Start

5/2/22

End

5/1/24

Labor Category	Hrs/Units	Rates	Cost
Principal Investigator/Project Manager: R. Nunu	791.00		22,157
Co-Investigator 1: G. Whittmeyer	282.00		28,252
Subtotal Hours/Labor Cost	1,073.00		50,408
		Fringe Burden	24,700
		<i>Subtotal Direct Labor</i>	<u>75,109</u>
		Overhead	72,755
		G&A	35,816
		COFC	1,158
		<i>Subtotal Labor Costs</i>	<u>184,838</u>
Material Costs:			
Equipment			0
Materials and Supplies			0
Subcontracting			80,000
Freight In			0
		<i>Subtotal Materials & Subcontracting</i>	<u>80,000</u>
		Mat Handling Burden	3,512
		<i>Subtotal Materials & Subcontracting & MHB</i>	<u>83,512</u>
Other Direct Costs			
Travel, Domestic			5,016
Travel, Foreign			0
Freight Out			0
Consultants			39,050
Services			87,584
Report Services			0
Photography			0
Communications			0
Other			0
		<i>Subtotal Other Direct Costs</i>	<u>131,650</u>
		Total Estimated Cost	<u>400,000</u>
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Budget Information - Non-Construction Programs

OMB Number: 4040-006
Expiration Date: 02/28/2022

Section A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Budget Period 1	15.557			\$103,161	\$112,466	\$215,627
2. Budget Period 2	15.557			\$96,839	\$87,534	\$184,373
3.						\$0
4.						\$0
5. Totals		\$0	\$0	\$200,000	\$200,000	\$400,000

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Prescribed by OMB (Circular A-102) Page 1

Section B - BUDGET CATEGORIES					
6. Object Class Categories	Grant Program, Function or Activity				Total (5)
	Budget Period 1	Budget Period 2	(3)	(4)	
a. Personnel	\$25,943	\$24,466			\$50,408
b. Fringe Benefits	\$12,712	\$11,988			\$24,700
c. Travel	\$2,508	\$2,508			\$5,016
d. Equipment	\$0	\$0			\$0
e. Supplies	\$0	\$0			\$0
f. Contractual	\$71,991	\$27,534			\$99,525
g. Construction					\$0
h. Other	\$43,792	\$63,317			\$107,109
i. Total Direct Charges (sum of 6a-6h)	\$156,945	\$129,813	\$0	\$0	\$286,759
j. Indirect Charges	\$58,681	\$54,560			\$113,241
k. Totals (sum of 6i-6j)	\$215,627	\$184,373	\$0	\$0	\$400,000
7. Program Income					\$0

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Section C - NON-FEDERAL RESOURCES				
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) Totals
8. Budget Period 1	\$0		\$112,466	\$112,466
9. Budget Period 2			\$87,534	\$87,534
				\$0
				\$0
Total (sum of lines 8 - 11)	\$0	\$0	\$200,000	\$200,000

Section D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th quarter
Federal	\$200,000	\$50,000	\$50,000	\$50,000	\$50,000
Non-Federal	\$200,000	\$50,000	\$50,000	\$50,000	\$50,000
Total (sum of lines 13 and 14)	\$400,000	\$100,000	\$100,000	\$100,000	\$100,000

Section E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT				
(a) Grant Program	Future Funding Periods (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
Budget Period 1	\$184,373	\$0	\$0	\$0
Budget Period 2				
Total (sum of lines 16-19)	\$184,373	\$0	\$0	\$0

Section F - OTHER BUDGET INFORMATION	

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Material, Equipment & Subcontract Detail

Equipment	<u>Budget Year</u>	<u>Description</u>	<u>Basis of Estimate</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>
	Budget Period 1					\$0.00
	Budget Period 1					\$0.00
	Budget Period 1					\$0.00
	Budget Period 1					\$0.00
					Subtotal	\$0.00
						<hr/>
Materials & Supplies	<u>Budget Year</u>	<u>Description</u>	<u>Basis of Estimate</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>
	Budget Period 1					\$0.00
	Budget Period 1					\$0.00
	Budget Period 1					\$0.00
	Budget Period 1					\$0.00
					Subtotal	\$0.00
						<hr/>
Subcontracts	<u>Budget Year</u>	<u>Company</u>	<u>Scope of Work</u>			<u>Amount</u>
	Budget Period 1	Reeves County GCD				\$15,000.00
	Budget Period 1	Middle Pecos GCD				\$27,466.00
	Budget Period 1	The Nature Conservancy				\$10,000.00
	Budget Period 1					\$0.00
					Subtotal	\$52,466.00
						<hr/>

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Material, Equipment & Subcontract Detail

Equipment	<u>Budget Year</u>	<u>Description</u>	<u>Basis of Estimate</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
					Subtotal	\$0.00
Materials & Supplies	<u>Budget Year</u>	<u>Description</u>	<u>Basis of Estimate</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
					Subtotal	\$0.00
Subcontracts	<u>Budget Year</u>	<u>Company</u>	<u>Scope of Work</u>			<u>Amount</u>
	Budget Period 2	Reeves County GCD				\$15,000.00
	Budget Period 2	Middle Pecos GCD				\$2,534.00
	Budget Period 2	The Nature Conservancy				\$10,000.00
	Budget Period 2					\$0.00
					Subtotal	\$27,534.00

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Travel Detail

Domestic			No. Staff	No. Days	Air	Lodging	M&IE	Car Rental	Total Cost			
Budget Period	Purpose	Destination	Per Trip	Per Trip	Fare	Rate	Rate	Rate	Misc*	per Trip	No. Trips	Travel Total
Budget Period 1	Field Data Collection	Balmorea, TX	2	5	\$ -	\$ 134.00	\$ 66.00	\$ 135.00	\$ 83.50	\$ 2,508.00	1	\$ 2,508.00
Budget Period 1										\$ -	1	\$ -
Budget Period 1										\$ -	1	\$ -
Budget Period 1										\$ -	1	\$ -
											Subtotal Domestic Travel	\$ 2,508.00
Foreign			No. Staff	No. Days	Air	Lodging	M&IE	Car Rental	Total Cost			
Budget Period	Purpose	Destination	Per Trip	Per Trip	Fare	Rate	Rate	Rate	Misc*	per Trip	No. Trips	Travel Total
Budget Period 1										\$ -	1	\$ -
Budget Period 1										\$ -	1	\$ -
Budget Period 1										\$ -	1	\$ -
Budget Period 1										\$ -	1	\$ -
											Subtotal Foreign Travel	\$ -

*Fuel for car rental, baggage fees, parking, cab fares, bus/rail passes

Travel Detail

Domestic			No. Staff	No. Days	Air	Lodging	M&IE	Car Rental	Total Cost			
Budget Period	Purpose	Destination	Per Trip	Per Trip	Fare	Rate	Rate	Rate	Misc*	per Trip	No. Trips	Travel Total
Budget Period 2	Field Data Collection	Balmorea, TX	2	5	\$ -	\$ 134.00	\$ 66.00	\$ 135.00	\$ 83.50	\$ 2,508.00	1	\$ 2,508.00
Budget Period 2										\$ -	1	\$ -
Budget Period 2										\$ -	1	\$ -
Budget Period 2										\$ -	1	\$ -
											Subtotal Domestic Travel	\$ 2,508.00

Foreign			No. Staff	No. Days	Air	Lodging	M&IE	Car Rental	Total Cost			
Budget Period	Purpose	Destination	Per Trip	Per Trip	Fare	Rate	Rate	Rate	Misc*	per Trip	No. Trips	Travel Total
Budget Period 2										\$ -	1	\$ -
Budget Period 2										\$ -	1	\$ -
Budget Period 2										\$ -	1	\$ -
Budget Period 2										\$ -	1	\$ -
											Subtotal Foreign Travel	\$ -

*Fuel for car rental, baggage fees, parking, cab fares, bus/rail passes

Other Direct Cost Detail

<u>Budget Year</u>	<u>Name</u>	<u>Scope of Work</u>	<u>Hours</u>	<u>Rate</u>	<u>Amount</u>
Consultant	Budget Period 1	Ron Green	177.5	\$110.00	\$19,525.00
	Budget Period 1				\$0.00
	Budget Period 1				\$0.00
	Budget Period 1				\$0.00
				Subtotal	\$19,525.00
<u>Budget Year</u>					<u>Amount</u>
Freight In	Budget Period 1				\$0.00
Freight Out	Budget Period 1				\$0.00
Services	Budget Period 1	LCRA-ELS: Ion/Isotope Analyses			\$36,752.00
Services	Budget Period 1	Tetra Tech: Boron Isotope Analyses			\$5,200.00
Services	Budget Period 1	U. of Pittsburgh: Nitrate Isotope Analyses			\$1,840.00
Report Services	Budget Period 1				\$0.00
Photography	Budget Period 1				\$0.00
Communications	Budget Period 1				\$0.00
Other	Budget Period 1				\$0.00
				Subtotal	\$43,792.00

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Other Direct Cost Detail

	<u>Budget Year</u>	<u>Name</u>	<u>Scope of Work</u>	<u>Hours</u>	<u>Rate</u>	<u>Amount</u>
Consultant	Budget Period 2	Ron Green		177.5	\$110.00	\$19,525.00
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
	Budget Period 2					\$0.00
					Subtotal	\$19,525.00
	<u>Budget Year</u>					<u>Amount</u>
Freight In	Budget Period 2					\$0.00
Freight Out	Budget Period 2					\$0.00
Services	Budget Period 1	LCRA-ELS: Ion/Isotope Analyses				\$36,752.00
Services	Budget Period 1	Tetra Tech: Boron Isotope Analyses				\$5,200.00
Services	Budget Period 1	U. of Pittsburgh: Nitrate Isotope Analyses				\$1,840.00
Report Services	Budget Period 2					\$0.00
Photography	Budget Period 2					\$0.00
Communications	Budget Period 2					\$0.00
Other	Budget Period 2					\$0.00
					Subtotal	\$43,792.00

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DIRECT LABOR RATES

DIRECT LABOR RATES: Rates for each labor category are estimated using weighted averages based on utilization and individual hourly salaries where applicable with appropriate escalation as follows:

<u>Fiscal Year</u>	<u>Prof/Tech</u>	<u>Clerical/Tech Help</u>
2021	0.000%	0.000%
2022	2.710%	2.280%
2023	2.860%	2.430%
2024	3.100%	2.570%

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BURDENS, INDIRECT RATES & FEE**1. BASE OF ALLOCATION**

- a. Fringe Burden: SwRI salaries and wages
- b. Overhead: Total direct SwRI labor
- c. General & Administrative: Total direct SwRI labor
- d. Cost of Facilities Capital: Total direct SwRI labor
- e. Material Handling Burden: Total cost of materials/supplies, subcontracting & freight in
- f. Fee: Total estimated cost less COFC.

2. BIDDING RATES

<u>Fiscal Year</u>	<u>Fringe</u>	<u>SwRI Site</u>				
		<u>Overhead</u>	<u>G&A</u>	<u>COFC</u>	<u>Fee</u>	<u>MHB</u>
2021	49.00%	97.59%	46.44%	1.446%	0.00%	4.22%
2022	49.00%	97.30%	46.03%	1.560%	0.00%	4.26%
2023	49.00%	96.87%	48.21%	1.544%	0.00%	4.42%
2024	49.00%	96.53%	48.01%	1.524%	0.00%	4.49%

ESCALATION ADJUSTMENT FACTOR CALCULATION
Budget Period 1

Professional & Technical				***Clerical & Technical Helper***			
Fiscal Year	Escalation Rate	No. of Months	Adj. by Year	Fiscal Year	Escalation Rate	No. of Months	Adj. by Year
2021	1.000000	0	0.0000	2021	1.000000	0	0.0000
2022	1.027100	5	5.1355	2022	1.022800	5	5.1140
2023	1.056475	7	7.3953	2023	1.047654	7	7.3336
2024	1.089226	0	0.0000	2024	1.074579	0	0.0000
2025	1.122447	0	0.0000	2025	1.104667	0	0.0000
2026	1.157692	0	0.0000	2026	1.136260	0	0.0000
2027	1.190339	0	0.0000	2027	1.168985	0	0.0000
2028	1.226049	0	0.0000	2028	1.203119	0	0.0000
2029	1.262831	0	0.0000	2029	1.238370	0	0.0000
2030	1.300715	0	0.0000	2030	1.274655	0	0.0000
2031	1.339737	0	0.0000	2031	1.312002	0	0.0000
2032	1.379929	0	0.0000	2032	1.350444	0	0.0000
2033	1.421327	0	0.0000	2033	1.390012	0	0.0000
2034	1.463967	0	0.0000	2034	1.430739	0	0.0000
2035	1.507886	0	0.0000	2035	1.472660	0	0.0000
Totals		12.0	12.5308	Totals		12.0	12.4476
Adjustments			1.04424	Adjustments			1.03730

4/21/2021

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ESCALATION ADJUSTMENT FACTOR CALCULATION
Budget Period 2

Professional & Technical				***Clerical & Technical Helper***			
Fiscal Year	Escalation Rate	No. of Months	Adj. by Year	Fiscal Year	Escalation Rate	No. of Months	Adj. by Year
2021	1.00000	0	0.0000	2021	1.00000	0	0.0000
2022	1.02710	0	0.0000	2022	1.02280	0	0.0000
2023	1.05648	5	5.2824	2023	1.04765	5	5.2383
2024	1.08923	7	7.6246	2024	1.07458	7	7.5221
2025	1.12245	0	0.0000	2025	1.10467	0	0.0000
2026	1.15769	0	0.0000	2026	1.13626	0	0.0000
2027	1.19034	0	0.0000	2027	1.16898	0	0.0000
2028	1.22605	0	0.0000	2028	1.20312	0	0.0000
2029	1.26283	0	0.0000	2029	1.23837	0	0.0000
2030	1.30072	0	0.0000	2030	1.27465	0	0.0000
2031	1.33974	0	0.0000	2031	1.31200	0	0.0000
2032	1.37993	0	0.0000	2032	1.35044	0	0.0000
2033	1.42133	0	0.0000	2033	1.39001	0	0.0000
2034	1.46397	0	0.0000	2034	1.43074	0	0.0000
2035	1.50789	0	0.0000	2035	1.47266	0	0.0000
Totals		12.0	12.9070	Totals		12.0	12.7603
Adjustments			1.07558	Adjustments			1.06336

4/21/2021

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Markup Factor Calculations

FRINGE BURDEN			
Budget Period 1			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	49.000%	0	0.0000
2022	49.000%	5	2.4500
2023	49.000%	7	3.4300
2024	49.000%	0	0.0000
2025	49.000%	0	0.0000
2026	49.000%	0	0.0000
2027	49.000%	0	0.0000
2028	49.000%	0	0.0000
2029	49.000%	0	0.0000
2030	49.000%	0	0.0000
2031	49.000%	0	0.0000
2032	49.000%	0	0.0000
2033	49.000%	0	0.0000
2034	49.000%	0	0.0000
2035	49.000%	0	0.0000
Totals		12.0	5.8800
Calculated Factor			49.0000%
OVERHEAD			
Budget Period 1			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	97.590%	0	0.0000
2022	97.300%	5	4.8650
2023	96.870%	7	6.7809
2024	96.530%	0	0.0000
2025	95.990%	0	0.0000
2026	95.310%	0	0.0000
2027	95.310%	0	0.0000
2028	95.310%	0	0.0000
2029	95.310%	0	0.0000
2030	95.310%	0	0.0000
2031	95.310%	0	0.0000
2032	95.310%	0	0.0000
2033	95.310%	0	0.0000
2034	95.310%	0	0.0000
2035	95.310%	0	0.0000
Totals		12.0	11.6459
Calculated Factor			97.0492%
G&A			
Budget Period 1			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	46.440%	0	0.0000
2022	46.030%	5	2.3015
2023	48.210%	7	3.3747
2024	48.010%	0	0.0000
2025	47.780%	0	0.0000
2026	47.510%	0	0.0000
2027	47.510%	0	0.0000
2028	47.510%	0	0.0000
2029	47.510%	0	0.0000
2030	47.510%	0	0.0000
2031	47.510%	0	0.0000
2032	47.510%	0	0.0000
2033	47.510%	0	0.0000
2034	47.510%	0	0.0000
2035	47.510%	0	0.0000
Totals		12.0	5.6762
Calculated Factor			47.3017%

4/21/2021

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Markup Factor Calculations

COST OF FACILITIES CAPITAL			
Budget Period 1			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	1.446%	0	0.0000
2022	1.560%	5	0.0780
2023	1.544%	7	0.1081
2024	1.524%	0	0.0000
2025	1.503%	0	0.0000
2026	1.483%	0	0.0000
2027	1.483%	0	0.0000
2028	1.483%	0	0.0000
2029	1.483%	0	0.0000
2030	1.483%	0	0.0000
2031	1.483%	0	0.0000
2032	1.483%	0	0.0000
2033	1.483%	0	0.0000
2034	1.483%	0	0.0000
2035	1.483%	0	0.0000
Totals		12.0	0.1861
Calculated Factor			1.5507%
MATERIAL HANDLING BURDEN			
Budget Period 1			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	4.220%	0	0.0000
2022	4.260%	5	0.2130
2023	4.420%	7	0.3094
2024	4.490%	0	0.0000
2025	4.530%	0	0.0000
2026	4.570%	0	0.0000
2027	4.570%	0	0.0000
2028	4.570%	0	0.0000
2029	4.570%	0	0.0000
2030	4.570%	0	0.0000
2031	4.570%	0	0.0000
2032	4.570%	0	0.0000
2033	4.570%	0	0.0000
2034	4.570%	0	0.0000
2035	4.570%	0	0.0000
Totals		12.0	0.5224
Calculated Factor			4.3533%
COST SHARE			
Budget Period 1			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	0.000%	0	0.0000
2022	0.000%	5	0.0000
2023	0.000%	7	0.0000
2024	0.000%	0	0.0000
2025	0.000%	0	0.0000
2026	0.000%	0	0.0000
2027	0.000%	0	0.0000
2028	0.000%	0	0.0000
2029	0.000%	0	0.0000
2030	0.000%	0	0.0000
2031	0.000%	0	0.0000
2032	0.000%	0	0.0000
2033	0.000%	0	0.0000
2034	0.000%	0	0.0000
2035	0.000%	0	0.0000
Totals		12.0	0.0000
Calculated Factor			0.0000%

4/21/2021

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Markup Factor Calculations

FRINGE BURDEN			
Budget Period 2			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	49.000%	0	0.0000
2022	49.000%	0	0.0000
2023	49.000%	5	2.4500
2024	49.000%	7	3.4300
2025	49.000%	0	0.0000
2026	49.000%	0	0.0000
2027	49.000%	0	0.0000
2028	49.000%	0	0.0000
2029	49.000%	0	0.0000
2030	49.000%	0	0.0000
2031	49.000%	0	0.0000
2032	49.000%	0	0.0000
2033	49.000%	0	0.0000
2034	49.000%	0	0.0000
2035	49.000%	0	0.0000
Totals		12.0	5.8800
Calculated Factor			49.0000%
OVERHEAD			
Budget Period 2			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	97.590%	0	0.0000
2022	97.300%	0	0.0000
2023	96.870%	5	4.8435
2024	96.530%	7	6.7571
2025	95.990%	0	0.0000
2026	95.310%	0	0.0000
2027	95.310%	0	0.0000
2028	95.310%	0	0.0000
2029	95.310%	0	0.0000
2030	95.310%	0	0.0000
2031	95.310%	0	0.0000
2032	95.310%	0	0.0000
2033	95.310%	0	0.0000
2034	95.310%	0	0.0000
2035	95.310%	0	0.0000
Totals		12.0	11.6006
Calculated Factor			96.6717%
G&A			
Budget Period 2			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	46.440%	0	0.0000
2022	46.030%	0	0.0000
2023	48.210%	5	2.4105
2024	48.010%	7	3.3607
2025	47.780%	0	0.0000
2026	47.510%	0	0.0000
2027	47.510%	0	0.0000
2028	47.510%	0	0.0000
2029	47.510%	0	0.0000
2030	47.510%	0	0.0000
2031	47.510%	0	0.0000
2032	47.510%	0	0.0000
2033	47.510%	0	0.0000
2034	47.510%	0	0.0000
2035	47.510%	0	0.0000
Totals		12.0	5.7712
Calculated Factor			48.0933%

4/21/2021

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Markup Factor Calculations

COST OF FACILITIES CAPITAL			
Budget Period 2			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	1.446%	0	0.0000
2022	1.560%	0	0.0000
2023	1.544%	5	0.0772
2024	1.524%	7	0.1067
2025	1.503%	0	0.0000
2026	1.483%	0	0.0000
2027	1.483%	0	0.0000
2028	1.483%	0	0.0000
2029	1.483%	0	0.0000
2030	1.483%	0	0.0000
2031	1.483%	0	0.0000
2032	1.483%	0	0.0000
2033	1.483%	0	0.0000
2034	1.483%	0	0.0000
2035	1.483%	0	0.0000
Totals		12.0	0.1839
Calculated Factor			1.5323%
MATERIAL HANDLING BURDEN			
Budget Period 2			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	4.220%	0	0.0000
2022	4.260%	0	0.0000
2023	4.420%	5	0.2210
2024	4.490%	7	0.3143
2025	4.530%	0	0.0000
2026	4.570%	0	0.0000
2027	4.570%	0	0.0000
2028	4.570%	0	0.0000
2029	4.570%	0	0.0000
2030	4.570%	0	0.0000
2031	4.570%	0	0.0000
2032	4.570%	0	0.0000
2033	4.570%	0	0.0000
2034	4.570%	0	0.0000
2035	4.570%	0	0.0000
Totals		12.0	0.5353
Calculated Factor			4.4608%
COST SHARE			
Budget Period 2			
Fiscal Year	Markup Factor	No. of Months	Adj. by Year
2021	0.000%	0	0.0000
2022	0.000%	0	0.0000
2023	0.000%	5	0.0000
2024	0.000%	7	0.0000
2025	0.000%	0	0.0000
2026	0.000%	0	0.0000
2027	0.000%	0	0.0000
2028	0.000%	0	0.0000
2029	0.000%	0	0.0000
2030	0.000%	0	0.0000
2031	0.000%	0	0.0000
2032	0.000%	0	0.0000
2033	0.000%	0	0.0000
2034	0.000%	0	0.0000
2035	0.000%	0	0.0000
Totals		12.0	0.0000
Calculated Factor			0.0000%

4/21/2021

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BASE LABOR ESCALATION ADJUSTMENT

Budget Period 1

LABOR CATEGORY	SwRI BASE RATE	ESCALATION ADJUSTMENT FACTOR	ADJUSTED HOURLY RATE
Principal Investigator/Project Manager	26.46	1.04424	27.63
Co-Investigator 1	94.54	1.04424	98.72

4/21/2021

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BASE LABOR ESCALATION ADJUSTMENT

Budget Period 2

LABOR CATEGORY	SwRI BASE RATE	ESCALATION ADJUSTMENT FACTOR	ADJUSTED HOURLY RATE
Principal Investigator/Project Manager	26.46	1.07558	28.46
Co-Investigator 1	94.54	1.07558	101.69

4/21/2021

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BASE LABOR RATE SUMMARY

LABOR CATEGORY	Budget Period 1	Budget Period 2
Principal Investigator/Project Manager	27.63	28.46
Co-Investigator 1	98.72	101.69

4/21/2021

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SwRI Proposal No. 15-91667

Attachment B
FORWARD PRICING RATE AGREEMENT

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA RD. 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

February 26, 2021

Ms. Danielle Gaines
Danielle.O.Gaines.civ@mail.mil
Administrative Contracting Officer
DCMA NASA Product Operations

Subject: Request for Forward Pricing Rate Agreement (FPRA)

Dear Ms. Gaines,

Southwest Research Institute® (SwRI) continues to submit a significant volume of Government contract proposals, many of which require indirect rates to be computed several years into the future. To reduce the contracting activities' administrative burden associated with verifying proposed indirect rates, we are requesting a FPRA.

We prepared the attached proposal for fiscal years 2021 through 2026 as a basis for establishing bidding and billing rates for Engineering Overhead (EO), G&A, Facilities Capital Cost of Money (FCCOM) and Material Handling Burden (MHB), as well as the pre-established Fringe Burden rate. We used the FY 2021 financial forecast as a baseline for estimating FY 2021 rates and applied long term financial projections from management, as well as external pricing factors, to project rates through 2026.

SwRI utilized the same forecast database sources and escalation methods as our previously submitted FPRP. The proposal includes a Forecast 5-yr projections 2021-2026 file, which lists the requested rates for each year and summarizes assumptions, estimates and factors used in preparing the proposal and supporting documentation which includes the FY 2021 forecast approved by the Board of Directors.

The rates calculated in this submission do not differ materially from current interim DCMA recommended rates. Therefore, we will update FY 2021 billing rates for EO, G&A, FCCOM and MHB prospectively upon your approval, and begin applying these rates for pricing new government prime and subcontract proposals at the beginning of period 7 (March 13th). The rates will remain effective until circumstances related to the pools or bases change materially enough to warrant a revised submission, or a FPRA is established with DCMA. Please let me know if you require additional information.

Sincerely,

Linda M. Boehme
Treasurer
cc: DCAA-SA (SwRI Office)
Beth Rafferty, SwRI
Troy Nagy, SwRI



Benefiting government, industry and the public through innovative science and technology

SOUTHWEST RESEARCH INSTITUTE

Forward Pricing Rates

FY 2021 - FY 2026

Summary of Calculated and Requested Rates for Overhead, G&A, and COFC

Note:

This schedule presents a summary of the rates as calculated in the attached workpapers compared to the rates requested by SwRI. The rate calculations can be found in Section B of the workpapers.

	2021	2022	2023	2024	2025	2026
	B 1	B2	B3	B4	B5	B6
Engineering Overhead - Regular Staff	97.59%	97.30%	96.87%	96.53%	95.99%	95.31%
Engineering Overhead - CCDG GVSC Staff	23.21%	23.51%	23.99%	24.52%	25.06%	27.05%
Engineering Overhead - Offsite Staff	1.41%	1.44%	1.47%	1.51%	1.55%	1.58%
General & Administrative	46.44%	46.03%	48.21%	48.01%	47.78%	47.51%
<u>Combined:</u>						
Regular Staff	144.03%	143.32%	145.09%	144.53%	143.77%	142.83%
CCDC GVSC Staff	69.65%	69.55%	72.20%	72.54%	72.83%	74.56%
Offsite Staff	47.85%	47.47%	49.68%	49.53%	49.33%	49.11%
COFC - Regular Staff	1.182%	1.277%	1.266%	1.253%	1.239%	1.223%
COFC - CCDG GVSC Staff	0.890%	0.896%	0.872%	0.850%	0.835%	0.823%
COFC - Offsite Staff	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
COFC - General & Administrative	0.264%	0.284%	0.278%	0.271%	0.265%	0.259%
<u>Combined:</u>						
Regular Staff	1.446%	1.560%	1.544%	1.524%	1.503%	1.483%
CCDC GVSC Staff	1.153%	1.180%	1.150%	1.123%	1.101%	1.082%
Offsite Staff	0.264%	0.284%	0.278%	0.271%	0.265%	0.259%
Material Handling Burden	4.22%	4.26%	4.42%	4.49%	4.53%	4.57%

SwRI Proposal No. 15-91667

Attachment C
FRINGE REQUEST LETTER

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • POST OFFICE DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

September 8, 2020

randy.d.allen10.civ@mail.mil

Mr. Randy Allen
Administrative Contracting Officer
Defense Contract Management Agency

SUBJECT: Pre-Established Fringe Burden Rate for Bidding and Billing Purposes

Dear Mr. Allen:

Southwest Research Institute has been carefully monitoring prior year calculation of our pre-established fringe burden rate compared with current fiscal year-to-date information and expected fringe cost estimates. Although it is extremely difficult to predict health care costs, especially considering the current pandemic health crisis, we have observed costs trending slightly downward over the past few years in response to cost controlling measures.

Therefore, and in compliance with CAS 418 requirements regarding pre-established rates, we have determined the fringe burden rate should be reduced from 50% to 49% effective with the start of fiscal year 2021 which begins September 26, 2020.

We are available to discuss this change at your convenience.

Sincerely,

Linda M.
Boehme

Digitally signed by
Linda M. Boehme
Date: 2020.09.08
09:30:38 -05'00'

Linda M. Boehme
Treasurer

cc: DCAA-SA (SwRI Office)



Benefiting government, industry and the public through innovative science and technology

SwRI Proposal No. 15-91667

Attachment D
LETTER OF COMMITMENT

SOUTHWEST RESEARCH INSTITUTE®

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Refer to: 15-91667
April 21, 2021

SHA-DRO-FAFOA@usbr.gov

BUREAU OF RECLAMATION

Denver Federal Center
P.O. Box 25007
86-69200
Denver, CO 80225

Attention: Ms. Avra Morgan
Program Analyst

Subject: Letter of Commitment
SwRI® Proposal No. 15-91667

Dear Ms. Morgan:

On behalf of Southwest Research Institute (SwRI), I certify that I am the authorized official to commit the applicant to the financial and legal obligations associated with receipt of a financial assistance award under this NOFO.

- W. Troy Nagy is the Director of the Contracts department of SwRI.
- I have reviewed and supports the application submitted;
- SwRI has received commitment letters from our cost share partners to provide the amount of funding and/or in-kind contributions; and
- That the applicant will work with the Bureau of Reclamation to meet established deadlines for entering into a grant or cooperative agreement.

If you have any questions, please contact Mr. Bryce DeWispelare at 210/522-5815, by facsimile at 210/522-3559, or via e-mail at bryce.dewispelare@swri.org.

Sincerely,



W. Troy Nagy
Director, Contracts

WTN/BDW/lsv

(COMPANY NAME)

Attention:

Refer to:

April 21, 2021

Page 2

cc: (_____), SwRI (via e-mail)

Agreed and Approved:

(CLIENT NAME)

By: _____

Name: _____

Title: _____

Date: _____

WTN/BDW/lsv

cc: (_____), SwRI (via e-mail)

City Of Balmorhea
P.O. Box 323
Balmorhea, Texas. 79718
cityofbalmorhea@mztv.net

April 13, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Applied Science NOFO
P.O. Box 25007, MS 84-27133
Denver, CO 80225

Re: Funding Opportunity R21AS00289

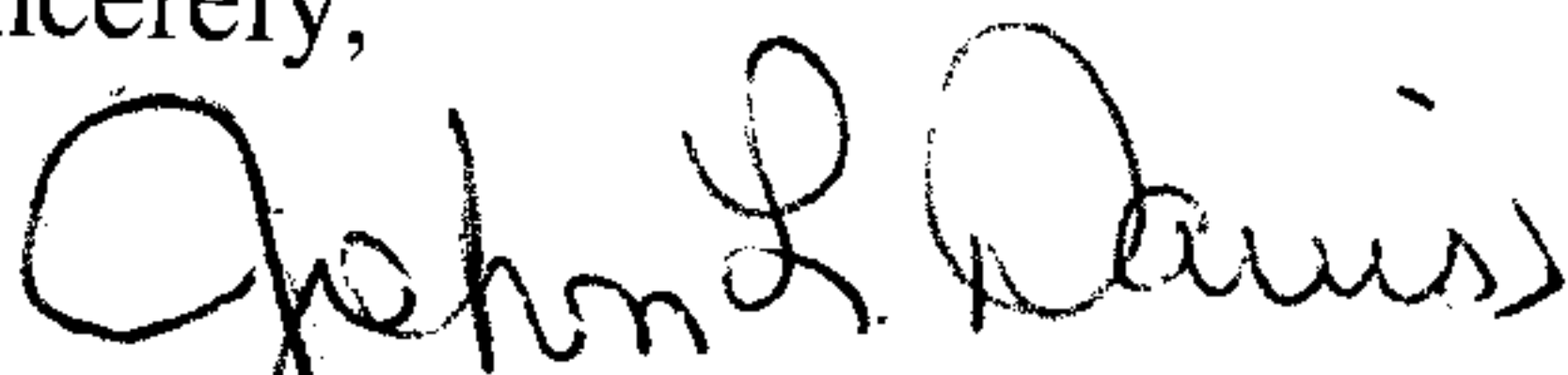
I am writing this letter to express my support for the Bureau of Reclamation Applied Science Grant proposal titled "Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA" led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

The Bureau of Reclamation Applied Science award sought by SwRI would enable the project team to continue these efforts with the result that water resource policy makers, including groundwater conservation districts, irrigation districts, county commissioners, city mayors, chambers of commerce, and non-governmental organizations would be able to identify and develop more-informed plans for economic development that are consistent with maintaining sustainable water resources for the future of the community and the environment.

Known as the Oasis in the Desert, it is difficult for the City of Balmorhea to overstate the importance of San Solomon Springs to the citizenry and economic health of its community. The ability for the City to make plans to grow the economy and at the same time secure the future sustainability of the springs would greatly empower the City to make informed decisions to prepare for changes in land use and climate. The City of Balmorhea looks forward to work with the SwRI project team to use the tools and database developed with the BOR Applied Science grant to make the best informed decisions to develop the economy and sustain the springs.

Please contact City Of Balmorhea at 432-375-2307 or cityofbalmorhea@mztv.net if you have any questions or comments.

Sincerely,



John L. Davis
Mayor

April 19, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Applied Science NOFO
P.O. Box 25007, MS 84-27133
Denver, CO 80225

Re: Funding Opportunity R21AS00289

I am writing this letter to express my support for the Bureau of Reclamation Applied Science Grant proposal titled "Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA" led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

The Bureau of Reclamation Applied Science award sought by SwRI would enable the project team to continue their efforts with the result that water resource policy makers, including groundwater conservation districts, irrigation districts, county commissioners, city mayors, chambers of commerce, and non-governmental organizations would be able to identify and develop more-informed plans for economic development that are consistent with maintaining sustainable water resources for the future of the community and the environment.

It is difficult to overstate the importance of our groundwater resources to the citizenry and economic health of communities in Reeves County. The ability for Madera Valley Water Supply Corporation to make plans to grow the economy and at the same time secure the future sustainability of water resources would greatly empower the Corporation to make informed decisions to prepare for changes in land use and climate. Madera Valley Water Supply Corporation looks forward to work with the SwRI project team to use the tools and database developed with the BOR Applied Science grant to make the best informed decisions to develop the economy and sustain our water resources.

Please contact Craig Huelster at (432)448-7192 or maderavalleywsc@yahoo.com if you have any questions or comments.

Sincerely,



Craig Huelster
Madera Valley Water Supply Corporation



April 20, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Applied Science NOFO
P.O. Box 25007, MS 84-27133
Denver, CO 80225

Re: Funding Opportunity R21AS00289

I am writing this letter to express my support for the Bureau of Reclamation Applied Science Grant proposal titled "Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA" led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

The Bureau of Reclamation Applied Science award sought by SwRI would enable the project team to continue these efforts with the result that water resource policy makers, including groundwater conservation districts, irrigation districts, county commissioners, city mayors, chambers of commerce, and non-governmental organizations would be able to identify and develop more-informed plans for economic development that are consistent with maintaining sustainable water resources for the future of the community and the environment.

The Meadows Center for Water and the Environment has been actively involved in investigating the water resources of Pecos County, in particular, Management Area 1 which is believed to be the source area for Comanche Springs. The Meadows Center has teamed with Texas Water Trade to explore the viability of returning perennial flow to Comanche Springs. In fact, the SwRI has collaborated on this effort.

The proposed project by the SwRI, which is regional in scale, would greater augment the work undertaken by Texas Water Trade and the Meadows Center. Accordingly, the Meadows Center endorses the SwRI BOR Applied grant proposal and will assist and collaborate to the degree possible given that the proposed project will clearly support the desire of the affected communities and stakeholders to make better informed decisions when planning to insure the future sustainability of the water resources of these arid and

THE MEADOWS CENTER FOR WATER AND THE ENVIRONMENT

601 University Drive | Spring Lake Hall, Room 108 | San Marcos, Texas 78666-4616

phone: 512.245.9200 | fax: 512.245.7371 | www.MEADOWSCENTER.TXSTATE.EDU

This letter is an electronic communication from Texas State University.

semi-arid environments. The Meadows Center will provide what input and feedback it can to insure the success of the SwRI led Applied Science project.

Please don't hesitate to contact me at (512) 470-7753 or robertmace@txstate.edu if you have any questions or comments.

Sincerely,

A handwritten signature in red ink, consisting of a series of loops and a long, sweeping tail that curves upwards and to the right.

Robert E. Mace, Ph.D., P.G.
Executive Director



April 14, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Applied Science NOFO
P.O. Box 25007, MS 84-27133
Denver, CO 80225

Subject: Letter of Support – Funding Opportunity R21AS00289

On behalf of the Environmental Defense Fund (EDF), I am pleased to write this letter indicating our support for the Bureau of Reclamation Applied Science Grant proposal titled “Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA” led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

The Bureau of Reclamation Applied Science award sought by SwRI would enable the project team to continue their efforts to better understand the source of recharge for spring systems in West Texas, with the important result that water resource policy makers, including groundwater conservation districts, irrigation districts, county commissioners, city mayors, chambers of commerce, and non-governmental organizations would be able to identify and develop more-informed plans for economic development that are consistent with maintaining sustainable water resources for the future of the community and the environment.

Founded in 1967, EDF is a leading international environmental non-profit organization representing more than 2.5 million members. Guided by science and economics, EDF focusses on strong science to inform policy and develop innovative solutions that address the most serious environmental problems. The proposed project clearly supports the goals and objectives of EDF by providing stakeholders with the means to ascertain what impact changes in land use and climate will have on the sustainability of fragile spring systems in arid and semi-arid environments.

EDF is very enthusiastic about this project and supports the grant proposal. EDF believes that a viable solution to water resource sustainability requires both strong science and broad support. The latter is achieved by engagement with groups and people from all sides to tackle challenges from many perspectives. Given our expertise and interest, EDF would advise and potentially assist in an outreach role to augment community participation and engagement. Examples would be communicating the objectives, efforts, and results to potential stakeholders particularly groundwater conservation districts; a critical party in the management of water resources that can

impact spring flow. These actions would elicit input from stakeholders and provide feedback to the research team throughout the project, applying valuable data and science to real world management solutions

Please let us know if you have any questions or need any further information.

Sincerely,

A handwritten signature in blue ink, appearing to read "Van Puig-Williams". The signature is fluid and cursive, with the first name "Van" and last name "Puig-Williams" clearly distinguishable.

Vanessa Puig-Williams
Director, Teas Water Program
Environmental Defense Fund
vpuigwilliams@edf.org

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

P.O. Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax (432)336-3407

405 North Spring Drive Fort Stockton, Texas 79735

Email: mpgcd@mpgcd.org

Website: www.middlepecosgcd.org

Directors

Jerry McGuairt, President Janet Groth, Vice President M. R. Gonzalez, Secretary/Treasurer

Alvaro Mandujano, Jr. Vanessa Cardwell Ronald Cooper

Weldon Blackwelder Allan Childs Jeff Sims Puja Boinpally Larry Drgac

Employees

Ty Edwards, General Manager

Office: Gail Reeves Field Technician: Anthony Bodnar

April 16, 2021

Southwest Research Institute
P.O. Drawer 28510
6220 Culebra Rd.
San Antonio, TX 78228-0510

Attn: Daria Galbraith

Copy:

U.S. Department of the Interior
Bureau of Reclamation

Subject:

Letter of Commitment Notice of Funding Opportunity No. R21AS00289 entitled WaterSMART: Applied Science Grants”

Dear Ms. Galbraith,

I am writing this letter to express my support for the Bureau of Reclamation Applied Science Grant proposal titled “Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA” led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

Middle Pecos Groundwater Conservation District is pleased to accept the request to serve as a Category A Applicant on the Applied Science Grant proposal. In particular, the evaluation tool that will be provided by this project will enable the understanding of our water resources so that the District can specify policies, guidance, and regulations to insure there will be sustainable water resources to meet the needs of our future residents and economy of our community. We currently have insufficient understanding of the hydrogeology of our District to adequately plan for our future water needs. This project will provide this understanding.

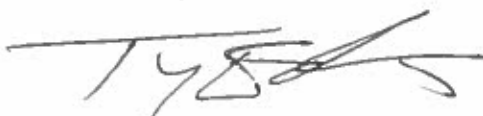
The District has assisted Southwest Research Institute since early 2020 in the efforts to better understand the water resources within our jurisdiction. This assistance has been in the form of providing access of springs and wells in the jurisdiction of the District. The District has also provided outreach to the community so that the local population is familiar with the team's project and the prospect of continuing this effort using funds from the Applied Science Grant. The District will in turn report on feedback that they receive from the community. This feedback will help the project team tailor its efforts to better respond to the needs of the community. The District will continue to provide this assistance to the Southwest Research Institute project team.

The District proposes to participate with Southwest Research Institute in all phases of the subject proposal and will support project activities. We understand that in addition to providing \$20,000 of paid labor, services and material to your institution for the referenced project, we will provide an additional \$30,000 of in-kind labor at no cost to this project or your institution over a two year period. The District has been awarded \$32,000 from The Nature Conservancy to refine a geologic model for the Diamond Y and Euphrasia Spring System, one of the iconic spring systems that will be studied in the proposed project. The District will provide \$25,000 of in-kind contributions from this project to the proposed Applied Science Grant. In-kind contributions will also include paid labor in the form of coordinating site access to springs and wells in the study area, providing input as the project progresses, and coordinating town hall meetings over the course of the project that will allow the project team to present their findings to the community.

In the event of an award, we also understand that for audit tracking we will be responsible for providing certification, showing the detailed amounts expended towards this project.

We are very confident in the merits of the proposed research and look forward to working with SwRI on this auspicious project.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ty Edwards', with a long horizontal stroke extending to the left.

Ty Edwards
General Manager



Reeves County Groundwater Conservation District

Greg Perrin, General Manager
119 South Cedar St.
Pecos, Texas 79772
432-445-9961

April 16, 2021

Southwest Research Institute
P.O. Drawer 28510
6220 Culebra Rd.
San Antonio, TX 78228-0510

Attn: Daria Galbraith

Copy:

U.S. Department of the Interior
Bureau of Reclamation

Subject:

Letter of Commitment Notice of Funding Opportunity No. R21AS00289 entitled
“WaterSMART: Applied Science Grants”

Dear Ms. Galbraith,

I am writing this letter to express the Reeves County Groundwater Conservation District (District) support for the Bureau of Reclamation Applied Science Grant proposal titled “Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA” led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute (SwRI).

The District is pleased to accept the request to serve as a Category A Applicant on the Applied Science Grant proposal. In particular, the evaluation tool that will be provided by this project will enhance the understanding of the water resources within the District. This tool and its supporting databases will improve our understanding of the hydrogeology in the region to help the District in its planning functions.

The District has assisted SwRI since late 2019 in the efforts to better understand the regional water resources. This assistance has been in the form of providing access to springs and wells in the jurisdiction of the District. The District has also provided outreach to the community so that the local population is familiar with the SwRI team’s project and the prospect of continuing this


effort using funds from the Applied Science Grant. The District will provide the SwRI research team with input and feedback that it receives from the community. This feedback will help the SwRI project team tailor its efforts to better respond to the needs of the community.

The District proposes to participate with SwRI in all phases of the subject proposal and will support project activities. The District will provide \$30,000 of in-kind services (subject to annual budget appropriation) at no cost to this project or your institution during the 24 months of the project duration, which is to be spread over 2022-2024. Hydrogeologists engaged by the District, which are currently are from the consulting firm Advanced Groundwater Solutions, LLC, , will be used by the District to provide in-kind support of time devoted to execution of the proposed project. In-kind contributions will also include paid labor from the General Manager and staff in the form of coordinating site access to springs and wells in the study area, providing input as the project progresses, and coordinating with stakeholders over the course of the project that will allow the project team to present its findings.

In the event of an award, the District understands that for audit tracking it will be responsible for providing certification, showing the detailed amounts expended towards this project.

The District is very confident in the merits of the proposed research and look forward to working with SwRI on this auspicious project.

Sincerely,

A handwritten signature in black ink, appearing to read "Greg Perrin", written in a cursive style.

Greg Perrin
General Manager

April 21, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Applied Science NOFO
P.O. Box 25007, MS 84-27133
Denver, CO 80225

Re: Funding Opportunity R21AS00289

I am writing this letter to express my support for the Bureau of Reclamation Applied Science Grant proposal titled "Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA" led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

The Horizon Foundation has a long history of supporting efforts and projects in west and central Texas that support conservation of the environment. In particular, the Foundation has supported projects to protect and sustain the water resources of fragile environments in semi-arid and arid lands. Support from the Horizon Foundation that is committed to this project will continue these efforts.

In addition, the Horizon Foundation works closely with governmental entities and non-governmental organizations in Texas to achieve the goals stated in the proposed project. The Foundation will incorporate the efforts and achievements of this project into the collaborations with these entities and organizations to amplify the impact of the project. Similarly, the Foundation will share feedback and insight gained in these interactions to insure the efforts of the proposed project are optimized.

The Horizon Foundation has reviewed and approved the cost share in the amount of \$100,000. The Horizon Foundation will enter into an agreement for performance of those project activities for which the PI is responsible. The Horizon Foundation will be glad to collaborate with the project team and work closely with them if the project gets funded.

Please contact Sally Anderson at 214-619-1422 or sally@horizondeercreek.com if you have any questions or comments.

Sincerely,

A handwritten signature in blue ink, appearing to read "Robert Potts", with a long horizontal line extending to the right.

Robert Potts
Director
The Horizon Foundation
5760 Legacy Dr, Suite B3-388
Plano, TX 75024
214-619-1422

April 20, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Applied Science NOFO
P.O. Box 25007, MS 84-27133
Denver, CO 80225

Re: Funding Opportunity R21AS00289

I am writing this letter to express my support for the Bureau of Reclamation Applied Science Grant proposal titled “Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA” led by Ms. Rebecca Nunu as the PI and Dr. Ronald Green and Dr. Gordon Wittmeyer as Co-PIs at Southwest Research Institute.

The Nature Conservancy (TNC) has collaborated with Southwest Research Institute (SwRI) on investigating the water resources in arid and semi-arid environments in Texas for over a decade. During this time, SwRI has proven to be an outstanding collaborator and has provided exceptional insight, guidance, and tools to help manage the limited water resources in the face of increasing challenges due to changes in land use (i.e., increased demand and pumping) and climate (i.e., uncertain and decreased recharge due to changes in precipitation).

The Bureau of Reclamation Applied Science award sought by SwRI would enable the project team to continue these efforts with the result that water resource policy makers, including groundwater conservation districts, irrigation districts, county commissioners, city mayors, chambers of commerce, and non-governmental organizations would be able to identify and develop more-informed plans for economic development that are consistent with maintaining sustainable water resources for the future of the community and the environment.

The mission of TNC mission is to conserve the lands and waters on which all life depends. This mission is clearly relevant in the arid and semi-arid lands of Texas. In support of this mission, TNC is the steward of numerous desert springs in west Texas and elsewhere in the globe. The ecological health of these fragile spring systems is critically important to the overall ecological and economic health of the greater region given the significant dependency of life on these sparse and iconic sources of water.

As a principal stakeholder, TNC would be an active recipient of the data-rich geochemical tools that SwRI would develop using the Applied Science grant. These tools would enable TNC to evaluate the anticipated impact that changes in land use and climate would have on west Texas spring systems. Such understanding and insight would position TNC and their collaborators (i.e., governmental entities and other NGOs) to make better informed decisions to insure that the water resources upon which the springs depend are sustainable.

TNC commits \$10,000 a year of in-kind support for each of the two years of the project for a total of \$20,000 of in-kind support. In addition, TNC will provide input into the databases necessary for extending the tools across the expanded study area. In addition, TNC will provide realtime feedback during the conduct of the Applied Science project to insure that the project outcomes are fully integrated into the needs of the community and stakeholders.

Please contact Ryan Smith at (210) 563-3677 or ryan_smith@tnc.org if you have any questions or comments.

Sincerely,

A handwritten signature in black ink, appearing to be 'Ryan Smith', with a horizontal line extending to the right.

Ryan Smith
Freshwater Ecologist
The Nature Conservancy
200 Grayson St., Suite 202
San Antonio, TX 78249
(210) 563-3677