

MEMORANDUM OF UNDERSTANDING

BETWEEN

THE U.S. DEPARTMENT OF THE INTERIOR,
BUREAU OF LAND MANAGEMENT, GILA DISTRICT,

AND

THE U.S. DEPARTMENT OF DEFENSE,
DEPARTMENT OF THE ARMY, U.S. ARMY GARRISON, FORT HUACHUCA,

AND

THE COUNTY OF COCHISE, ARIZONA,

AND

THE CITY OF SIERRA VISTA, ARIZONA.

SUBJECT: Memorandum of Understanding (MOU) for Cooperative Monitoring and Management of the San Pedro Riparian National Conservation Area and Surrounding Areas within Cochise County, Arizona.

1. Purpose.

The purpose of this MOU is to provide a proposed path for implementing monitoring and management actions necessary to ensure the mutually shared goals of an ecologically viable San Pedro Riparian National Conservation Area, an operationally secure Fort Huachuca, and the economic prosperity of the City of Sierra Vista and Cochise County.

2. Background.

The Bureau of Land Management (BLM) manages the San Pedro Riparian National Conservation Area (SPRNCA) according to statutory authority and pursuant to its management goals and objectives identified in the SPRNCA Resource Management Plan. Public Law 100-696 (codified at 16 U.S.C. § 460xx) established the SPRNCA, providing specifically:

In order to protect the riparian area and the aquatic, wildlife, archeological, paleontological, scientific, cultural, educational, and recreational resources of the public lands surrounding the San Pedro River in Cochise County, Arizona, there is hereby established the San Pedro Riparian National Conservation Area (hereafter in this subchapter referred to as the “conservation area”).

16 U.S.C. § 460xx(a). Section § 460xx-1(a), related to the Secretary’s “General Authorities” with regard to SPRNCA, states, in part, that “The Secretary shall manage the conservation area in a manner that conserves, protects, and enhances the riparian area and the aquatic, wildlife, archaeological, paleontological, scientific, cultural, educational, and recreational resources of the conservation area.” The BLM uses the SPRNCA Record of Decision and Approved Resource Management Plan (RMP), released 7/30/2019, to guide management of the BLM-administered lands in the SPRNCA in a manner which ensures that all actions meet the need to conserve, protect, and enhance the legislated primary purposes: the riparian area and the aquatic, wildlife, archaeological, paleontological, scientific, cultural, educational, and recreational resources. While nothing in the RMP is intended to address the quantity of water reserved to achieve the purposes of the SPRNCA, it does establish specific indicators for protecting SPRNCA’s legislated primary purposes and defines various water-related goals and

objectives associated with ecological conditions for each of these resource management categories that the BLM has determined are necessary to conserve, protect, and enhance the SPRNCA in furtherance of those primary purposes. These water-related indicators, goals and objectives associated with ecological conditions are hereafter referred to as the “RMP Objectives.”

Fort Huachuca is a U.S. Army installation in Southeastern Arizona. It is a major Army training and testing post in support of national defense. Collaborative partnerships with neighboring communities and organizations assist the Fort in completing its missions, being a responsible stakeholder and in protecting local natural resources. Some of Fort Huachuca’s objectives in participating in this MOU include:

- To assist compliance with Fort Huachuca’s Biological Opinions and its obligations under the Endangered Species Act.
- To ensure a safe and adequate water supply for Fort Huachuca personnel and service members to successfully accomplish the Fort’s missions.
- To jointly work with appropriate local partners to effectively manage the many natural resources within the SPRNCA and the Upper San Pedro River Basin to fulfill the objectives of the Fort Huachuca Sentinel Landscape strategic plan.

Cochise County, Arizona (the “County”) fosters diverse, vibrant and safe communities, planning for the future while honoring its legendary cultural heritage. Cochise County’s relevant strategic priorities include:

- Economic development countywide;
- Promoting environmental solutions, including partnerships for wildlife management in the San Pedro Riparian National Conservation Area and supporting Fort Huachuca environmental efforts; and
- Increased intergovernmental cooperation.

The County’s Comprehensive Plan, amended and readopted in 2015, has as a goal specific to SPRNCA: “Coordinate efforts with other organizations and jurisdictions, including the Bureau of Land Management, to protect the SPRNCA, as well as the economic and social well-being of Cochise County residents, by assisting Fort Huachuca in meeting its environmental goals, especially regarding water conservation.”

The City of Sierra Vista, Arizona (the “City”) provides quality services and amenities through strategic and ethical leadership and is committed to building a strong, healthy, and vibrant community where its residents can prosper. The City’s strategic priorities relevant to participating in this MOU include:

- Enhancing the City by providing better services and enhancing the appearance of the City to better reflect core community values and utilizing partnerships for a stronger community, including:
 - Improving streetscapes and public places by implementing at least two projects per year.
 - Revitalizing the West End, including exploring ways to improve stormwater management to reduce flooding.
- Leveraging partnerships with other governmental, commercial and non-profit interests even further to influence the economic prosperity of both the City and its residents and focus on issues affecting the most vulnerable City residents, including:
 - Expanding intergovernmental service agreements and partnerships that support the Fort’s missions, create revenue, and take advantage of economies of scale.
 - Plan for reclaimed and other water use, and continue to partner with public and private agencies to implement water conservation and recharge projects to promote the long term stability of our local aquifer.

- Provide a variety of recreation opportunities, including:
 - Evaluate and plan for park space, sports complex, and recreational properties.

All of the parties recognize that there are complex interactions between hydrology, ecosystems, and human development and use of the landscape, and achievement of many of the RMP Objectives will be promoted by ongoing coordination and collaboration among the parties to this MOU. Recognizing that there is a long history of effort by many different parties in the region, and that there are many existing projects, partnerships, and management actions in place, this MOU provides a framework to deliberately connect and coordinate these various ongoing efforts among the parties by:

- Identifying shared goals and points of mutual interest;
- Developing a consensus with regard to the shared benefit of the many activities that are planned or underway in the region that might further the shared goals and points of mutual interest;
- Outlining the responsibilities of the respective parties concerning implementation of mutually-beneficial monitoring and management activities;
- Defining a process for ongoing collaborative actions, evaluation of monitoring results, adaptive management actions, and conflict management procedures; and
- Establishing a framework within which further agreement(s) among the parties that may be necessary for implementation of collaborative actions described in this MOU can be developed.

3. Shared Goals and Points of Mutual Interest

The parties have identified the following common goals and shared interests related to an ecologically viable San Pedro Riparian National Conservation Area, an operationally secure Fort Huachuca, and the economic prosperity of the City of Sierra Vista and Cochise County. Collectively, these common goals and shared interests are referred to herein as the “MOU Objectives”:

- An adequate long-term water supply is available to meet the reasonable needs of the area’s residents and property owners (current and future) and fulfill the purposes of the SPRNCA, while managing the impacts of past groundwater use;
- The San Pedro River within the SPRNCA is healthy, and the RMP Objectives are advanced, thereby furthering the primary purposes for which the SPRNCA was established;
- Communities in areas around the SPRNCA within Cochise County, Arizona, are strong, healthy, diverse, vibrant, and safe, and have opportunities for continued economic growth and development, which fosters local community capacity to support regional water-related objectives;
- Fort Huachuca is able to accomplish its national defense missions, have a safe and adequate water supply and comply with all obligations under the Endangered Species Act; and
- Local, state, and federal agencies and partner organizations work collaboratively to reduce environmental, economic, and water supply risks and avoid conflicts related to local water use and federally reserved rights.

4. Consensus of Shared Benefit(s) of Ongoing and Planned Activities

The accumulated impacts of past groundwater use in the Sierra Vista Subwatershed, as they are presently understood, support the continuation of water conservation and recharge efforts as an important means of

ensuring that the RMP Objectives – and the primary purposes of federal reserved rights - can be met over the long term. The BLM recognizes that although the SPRNCA federal reserved water rights are expected to be decreed as part of the Gila River General Stream Adjudication, the mere quantification of those reserved rights will not achieve the RMP Objectives. In addition, even to the extent it is feasible, mere enforcement of the federal reserved rights is unlikely to achieve the RMP Objectives, and is likely to generate conflicts between federal interests, adjacent communities, and local stakeholders. The parties further acknowledge that the establishment of a process to reduce/resolve conflicts may expedite achievement of the RMP Objectives by improving relationships and reducing the likelihood of resources being diverted to litigation costs rather than activities aimed at advancing RMP Objectives.

The parties recognize the value of already-undertaken conservation and recharge efforts to manage local groundwater sustainability challenges and protect the San Pedro River, which are key to advancing the RMP Objectives. These efforts will also assist the Fort in meeting its Endangered Species Act (ESA) requirements as established in biological opinions from the U.S. Fish and Wildlife Service and ensure the long-term sustainability of the Fort. The parties similarly recognize the importance of local management efforts and actions in meeting the RMP Objectives, which are included within the MOU Objectives, and avoiding conflict between local water use and federal reserved water rights. The parties wish to explore how their ongoing, planned, and potential future actions could (1) help to complement BLM's planned actions and advance or achieve RMP Objectives and, (2) potentially satisfy the primary purposes of federal reserved water rights. The parties acknowledge that all are likely to benefit from collaborative planning and financing efforts to equitably and efficiently carry out activities that will achieve the shared MOU Objectives.

The parties therefore agree that the preferred approach for promoting implementation of the MOU Objectives is to undertake proactive, collaborative actions that will meet their common goals. The parties also recognize that their proactive, collaborative actions will be acting upon the Sierra Vista Subwatershed's and Upper San Pedro Basin's dynamic hydrological and ecological systems that have changed over time and are continuing to change in response to impacts from both human and natural causes, including groundwater use, changes in landscapes and land management, and changes in climate. To provide a basis for ongoing collaborative action, the parties have worked to identify a monitoring framework that can be used to (1) objectively assess trends in relevant hydrological, biological, and ecological conditions in reference to recent conditions; (2) determine whether the cumulative actions being undertaken by the parties are objectively working to maintain or improve trends towards meeting the MOU Objectives over time; and (3) inform potential responses and adjustments to their collaborative actions accordingly.

5. Responsibilities of the Parties

The parties have determined that it is in their best interests to cooperate on three principal components to implement the mutually-beneficial activities and achieve the MOU Objectives:

- **Monitoring Indicators** – objectively assess and/or model trends in relevant hydrological, biological, and ecological conditions in reference to their shared goals, assess the impacts of management actions, and identify when adaptive management actions may be required. The parties will work together to acquire needed funding to support this monitoring and assessment, which is described in the Cooperative Monitoring and Adaptive Management Plan attached as Appendix A.
- **Management Actions** – identify and coordinate implementation of management actions that are designed to maintain or improve trends in hydrological, biological, and ecological conditions relevant to the MOU Objectives. The parties will work together to acquire needed funding to undertake these joint efforts. Current/ongoing and planned management actions relevant to this MOU are described in the Cooperative Monitoring and Adaptive Management Plan attached as Appendix A.

- Adaptive Management Responses – establish a formal process to initiate and implement adaptive management responses based on the ongoing review of Monitoring Indicators, with the objective of identifying and implementing consensus-based actions and avoiding conflicts between the federal management objectives and the interests of local jurisdictions and stakeholders, including situations in which the monitoring targets defined in Appendix A and/or the water-related goals of the individual parties are not being met.
- 5.1. Specifically, each party agrees to work in good faith with the other parties and to enter into additional agreement(s) as necessary to implement the mutually-beneficial actions described in the Cooperative Monitoring and Adaptive Management Plan (appended hereto as Appendix A), including the following:
 - 5.1.1. Collecting, analyzing, and reporting data and/or modeling information related to the identified monitoring indicators in a mutually-agreed upon schedule and format to the parties;
 - 5.1.2. Continuing, to the extent feasible, with the party’s own current and ongoing activities;
 - 5.1.3. Participating in collaborative planning, development, and funding for the ongoing and joint monitoring and management activities; and
 - 5.1.4. Seeking necessary funding to implement the cooperative monitoring and management actions.
 - 5.2. Each party agrees to utilize the adaptive management procedures identified in Section 6 of this MOU to resolve issues and avoid potential conflicts between the parties, including:
 - 5.2.1. Identifying a representative to sit on the Adaptive Management Committee (as further defined in Section 6 below);
 - 5.2.2. Delegating technical support functions to individual parties, the Upper San Pedro Partnership, Cochise Conservation and Recharge Network, technical working groups, or other organizations as appropriate and necessary; and
 - 5.2.3. Identifying and implementing consensus-based actions based on monitoring indicators and technical support functions to achieve the shared goals and points of mutual interest.

6. Procedures for Adaptive Management Response Actions

- 6.1 Immediately following the execution of this MOU, the parties will establish a MOU Adaptive Management Committee (“Adaptive Management Committee”) consisting of one manager or representative from each party. The Adaptive Management Committee will be responsible for the ongoing implementation of this MOU, including coordinating and delegating technical support functions, evaluating and reporting monitoring and modeling outcomes, and recommending consensus-based responses based on such outcomes.
 - 6.1.1 The Adaptive Management Committee may conduct its business through any form of written or electronic communications, in-person or remote meetings, and shall take action by consensus of the representatives to the Adaptive Management Committee. Each party shall have one voting representative on the Adaptive Management Committee.
 - 6.1.2 By consensus, the Adaptive Management Committee may invite or appoint such other persons (whether associated with the parties or any other organization) to attend its meetings and/or advise or support the Adaptive Management Committee. Such invitee shall not be a voting member of the Adaptive Management Committee.
- 6.2 The Adaptive Management Committee will, within 180 days of execution of this MOU, develop and begin carrying out a detailed implementation plan for the initial and ongoing data collection, modeling,

evaluation, and reporting activities for monitoring and assessing indicator trends consistent with the terms of the Cooperative Monitoring & Adaptive Management Plan appearing in Appendix A (the “Implementation Plan”).

6.2.1 The Implementation Plan will:

6.2.1.1 Include a description of the actions, schedule, and costs to evaluate the current status and projected trends of riparian health pursuant to the methodology described in Appendix A (including identification of the model(s) to be used for the initial evaluation of indicator trends), and a schedule for the periodic reporting of results to the Adaptive Management Committee.

6.2.1.2 Be maintained as a working document and shall be updated by the Adaptive Management Committee from time to time as may be determined by a consensus of the Adaptive Management Committee.

6.2.2 The Adaptive Management Committee will promptly arrange for any technical support functions necessary to carry out the initial and ongoing activities detailed in the Implementation Plan, which may, by consensus, be delegated to one or more of the individual parties, the Upper San Pedro Partnership, Cochise Conservation and Recharge Network, U.S.G.S., or such other parties or agreed-upon technical experts as the Adaptive Management Committee may determine to be appropriate and necessary.

6.3 At the request of any party, but in any event not less than once annually, the Adaptive Management Committee shall undertake a review of the results of monitoring and modeling activities, as follows:

6.3.1 The Adaptive Management Committee shall use the results of monitoring and modeling activities conducted pursuant to this MOU, together with any other relevant information that may be available to the parties, to assess indicator trends in each of the demarcated reaches of the SPRNCA (each, a “SPRNCA Reach”) pursuant to the maps and methodology described in Appendix A. As part of its review, the Adaptive Management Committee shall, based on a comparison between the current or recently observed conditions for a SPRNCA Reach, and projected future trends or modeling forecasts for conditions in that same SPRNCA Reach, assess whether each SPRNCA Reach may need additional or alternative monitoring or management based on the decision matrix appearing in Table 2 of Appendix A.

6.3.2 Based on the information available to the Adaptive Management Committee and assessed indicator trends as detailed in Section 6.3.1, the Adaptive Management Committee shall evaluate the likely impact, if any, of the current management actions being undertaken by the parties, assess whether any changes to current management actions may be beneficial to the purposes of the MOU, and determine whether any such changes should be recommended to the parties for consideration.

6.3.3 In the event the Adaptive Management Committee determines that assessed indicator trends indicate that a particular SPRNCA Reach may need additional or alternative monitoring or management, the Adaptive Management Committee will, within 90 days of its assessment of the same, make a consensus-based recommendation to the appropriate decision-maker(s) for each of the parties as to:

6.3.3.1 Whether continued or additional monitoring might be desirable to better assess trends in the affected SPRNCA Reach, adjacent SPRNCA Reaches, and/or assess the impact of current or planned management actions on such trends, and, if so:

(a) any additional technical support that would be desirable in making that assessment,

- (b) the timeframe for undertaking any additional assessment,
 - (c) cost estimates for the same, if available, and
 - (d) funding options or opportunities, if available.
- 6.3.3.2 The anticipated impacts of current management actions on the SPRNCA Reach, and whether those actions may be sufficient to address the undesirable trend over time.
- 6.3.3.3 If current management actions are not anticipated to be sufficient to address the undesirable trend:
 - (a) whether changes to existing management actions and/or additional management action(s) may be warranted to meet the goals of the MOU with regard to the SPRNCA Reach;
 - (b) what additional management action(s) might be considered, which of the parties or any third parties may have the capability and/or jurisdiction to implement those actions;
 - (c) a suggested timeframe for the implementation of any such actions;
 - (d) cost estimates for such actions, if available; and
 - (e) funding options or opportunities, if available.
- 6.3.4 If the Adaptive Management Committee is unable to reach a consensus-based recommendation on a particular matter pursuant to this Section, the Adaptive Management Committee will notify the parties of such point of disagreement and the SPRNCA Reach(es) affected.
- 6.3.5 The Adaptive Management Committee may, by consensus, delegate technical support functions related to review, evaluation, and development of recommendations as necessary for the Adaptive Management Committee to undertake these functions.
- 6.4 Upon receiving consensus-based recommendations from the Adaptive Management Committee, the parties will work in good faith to implement those consensus-based recommendations, which may include entering into additional agreement(s), amending this MOU and/or Cooperative Monitoring & Adaptive Management Plan, and/or integrating such activities into the Implementation Plan as may be deemed necessary and appropriate by the parties.
- 6.5 If the Adaptive Management Committee notifies the parties that it has been unable to reach a consensus-based recommendation as to a particular matter:
 - 6.5.1 Any party may request that the Adaptive Management Committee meet at least once during the next 90 days to reconsider the matter, together with any recommendations made by the parties as to the matter, and seek to make a consensus-based recommendation;
 - 6.5.2 Prior to taking any action inconsistent with the MOU Objectives or cooperative management efforts of this MOU, each party shall, to the extent consistent with its legal authorities and responsibilities, seek to formally consult with the other parties to the MOU to determine if the dispute can be resolved;
 - 6.5.3 Upon the determination of any party that the dispute cannot be resolved, any party (the “objecting party”) may suspend the objecting party’s participation in the terms of this MOU as to the particular matter(s) associated with the point of disagreement and/or with regard to the affected SPRNCA Reach(es) by providing written notification to the other parties; provided, that the parties, including the objecting party, shall continue to work in good faith

to implement the terms of this MOU and the cooperative actions being undertaken hereunder with regard to all other matters unrelated to the particular dispute. If there are multiple objecting parties, the subject of the dispute shall be tabled and other actions will be evaluated by the Adaptive Management Committee. A dispute under this Section will not excuse, impact or interfere with any party's existing or on-going management actions, which may involve contractual or other legal obligations.

- 6.6 From time to time, the Adaptive Management Committee may consider whether to alter the Cooperative Monitoring and Adaptive Management Plan appearing in Appendix A, including the evaluative criteria utilized by the parties in the decision matrix appearing in Table 2 of Appendix A. The parties may seek the recommendations of the Technical Advisors to Upper San Pedro Technical Committee in considering any such alterations, together with any other technical experts that the Adaptive Management Committee may elect to consult. Any alterations to the Cooperative Monitoring and Adaptive Management Plan will be made by consensus.

7. Limitations

The intent of this MOU and all documents attached hereto, is to provide a means for the parties to attempt to reach and sustain a consensus on ways to achieve the RMP and MOU Objectives and meet their shared goals and mutual points of interest. Accordingly:

- 7.1. The parties specifically acknowledge that this MOU is not an obligation of funds, nor does it constitute a legally binding commitment by any party or create any rights in any non-signatory.
- 7.2. The parties specifically recognize and agree that the monitoring activities and indicators described in Appendix A should not be understood as an agreement by any party that the condition of any SPRNCA Reach, as that condition may be evaluated based on the methodology in Appendix A, should be evaluated with reference to any particular historic baseline condition, nor does the failure of any SPRNCA Reach to meet a particular condition obligate the parties to take any further action except as expressly stated herein.
- 7.3. The parties are presently involved in litigation related to claims to federal reserved water rights in the San Pedro River in the Gila River Adjudication. Nothing contained herein shall be deemed an admission respecting or admissible as evidence in that or any other proceedings amongst or involving any one or more of the parties. Any party may point to its participation in this MOU as evidence of action(s) that the party is or is planning to undertake with reference to the MOU Objectives, which include the RMP Objectives, or any of the parties' other stated goals and objectives.

8. Addition of New Parties to this Memorandum of Understanding

With written approval of all existing parties to this MOU, any local jurisdiction, state agency, federal agency having jurisdiction over areas addressed by this MOU and Cooperative Monitoring and Adaptive Management Plan, or any other interested governmental or non-governmental organization may join in this MOU and execute agreements to join in or undertake further activities in support of this MOU and Cooperative Monitoring & Adaptive Management Plan. Upon joining in this MOU and Cooperative Monitoring & Adaptive Management Plan, such joining entity or organization shall appoint a representative who shall participate in the Adaptive Management Committee as described above.

9. Withdrawal from the Memorandum of Understanding

Any party to this MOU may withdraw from the MOU at any time upon written notice to all other parties. After withdrawal from the MOU, such withdrawing party may become a signatory to the MOU after approval in accordance with the provisions of Section 8 herein.

10. Other Modifications of the Memorandum of Understanding

The parties may modify this MOU only by mutual written agreement.

IN WITNESS WHEREOF, the duly authorized representative of each party has executed this MOU as of the 21st Day of September, 2021.

GILA DISTRICT,
BUREAU OF LAND MANAGEMENT
THE U.S. DEPARTMENT OF THE INTERIOR

FORT HUACHUCA, U.S. ARMY GARRISON
DEPARTMENT OF THE ARMY
THE U.S. DEPARTMENT OF DEFENSE

COUNTY OF COCHISE, ARIZONA

CITY OF SIERRA VISTA, ARIZONA

Appendix A

San Pedro Riparian National Conservation Area Cooperative Monitoring & Adaptive Management Plan

A.1. Monitoring – Introduction

The purpose of this San Pedro Riparian National Conservation Cooperative Monitoring & Adaptive Management Plan (SPRNCA Cooperative Plan, or Plan) is to document a monitoring framework and associated activities that are designed to support the Memorandum of Understanding for Cooperative Monitoring and Management of the San Pedro Riparian National Conservation Area and Surrounding Areas within Cochise County, Arizona, dated September 21, 2021 (MOU). The SPRNCA Cooperative Plan is intended to provide a basis for parties participating in the MOU to objectively assess trends in relevant hydrological, biological, and ecological conditions within and adjacent to the San Pedro Riparian National Conservation Area (SPRNCA) in reference to current or recent conditions; (2) assess whether specific or cumulative management actions are successfully maintaining or improving trends towards desired conditions over time; and (3) provide data that could inform potential responses and adjustments to management actions.

The monitoring activities described in the SPRNCA Cooperative Plan are associated with meeting the MOU Objectives. As described in the MOU, the MOU Objectives include (among other elements) certain water-related objectives identified by the U.S. Bureau of Land Management (BLM) in its 2019 San Pedro Riparian National Conservation Area Resource Management Plan (RMP) that depend upon water availability, and the associated federal reserved water rights. Specifically, the RMP objective relative to health of the overall riparian ecosystem (ob-WAT-3) states:

Provide adequate water quantities to sustain aquatic habitat, woody vegetation comprised of cottonwood, willow, and other native deciduous riparian trees and to meet desired ecological conditions, especially those for tree regeneration, native aquatic species, and federally listed aquatic species.

To address this objective and shared goals and mutual interests detailed within the MOU, the SPRNCA Cooperative Plan focuses on current and future riparian ecosystem health of the SPRNCA, the data required to define riparian health over time, previous studies and analyses, and estimated annual costs.

The SPRNCA Cooperative Plan utilizes certain of the indicators of sustainable groundwater use that have been defined for the Sierra Vista Subwatershed by the United States Geologic Survey (*Hydrological Conditions and Evaluation of Sustainable Groundwater Use in the Sierra Vista Subwatershed, Upper San Pedro Basin, Southeastern Arizona* (Gungle et al., 2016)) as key variables to assess and predict the riparian health of the SPRNCA now and in the future. Several investigations conducted for the SPRNCA over the past two decades by the collaborating members of the Upper San Pedro Partnership have also been used as a basis for developing this monitoring framework using both empirical monitoring data, as well as the relationships that have been defined between hydrology and the riparian ecosystem.

Studies and reports used to inform this SPRNCA Cooperative Plan include, but are not limited to: *Hydrologic Requirements of and Consumptive Ground-Water Use by Riparian Vegetation along the San Pedro River, Arizona* (Leenhouts et al., 2006); *Hydrological Conditions and Evaluation of Sustainable Groundwater Use in the Sierra Vista Subwatershed, Upper San Pedro Basin, Southeastern Arizona* (Gungle et al., 2016); *Riparian Conditions Along the San Pedro River, Proper Functioning Condition Riparian Assessment Report*, National Riparian Service Team (NRST 2012); and *Water Management of the Regional Aquifer in the Sierra Vista Subwatershed, Arizona* (a series of reports prepared for the U.S. Congress; U.S. Department of the Interior, 2005, 2006, 2007,

2008, 2011, 2012, 2013, 2014). The development of the SPRNCA Cooperative Plan has been advised by the U.S. Geological Survey (USGS) to assess its technical consistency with the RMP Objectives.

A.2. Riparian Health

The Adaptive Management Committee will review and rely upon various data, studies, metrics, or analyses in performing its Adaptive Management Responses based upon the best available science, and will assess both the changing hydrological and ecological conditions in the various SPRNCA Reaches, as defined in this Section, and the effectiveness of their management actions with regard to the MOU Objectives.

To provide an initial framework for this evaluation, the USGS has recommended the riparian health condition classes defined by Leenhouts et al. (2006) for the SPRNCA as an effective and relatively comprehensive metric to use for evaluating hydrologic integrity and associated ecosystem health that can be spatially and temporally specific, and from which relevant trends in riparian health conditions can be measured or inferred.

SPRNCA has been categorized in previous studies into three riparian health classes—Classes 1, 2, and 3--which were further segregated into 14 reaches within the SPRNCA. (Leenhouts et al. 2006) The delineation of these reaches was based on their respective geomorphic, hydrologic and biological characteristics, and these same 14 delineated reaches are being adopted by the SPRNCA Cooperative Plan for monitoring, evaluation, and planning purposes (each hereafter referred to as a “SPRNCA Reach” or “Reach”). The location and spatial extent of each of these reaches is shown in the map (adapted from Leenhouts et al. 2006) included as Figure 1.

Because the primary intent of the Plan is to provide a basis for ongoing, cooperative action by seeking to maintain or improve the trend in riparian conditions, the parties will utilize this framework of riparian condition classes to both assess current conditions and to model projected trends in those conditions over time within each SPRNCA Reach (and across multiple reaches). Based on this information, the parties will use the framework to assess whether current and planned management actions are successfully maintaining or improving trends in these conditions and will guide potential responses and adjustments to cooperative management actions and activities accordingly.¹

As noted in the MOU, the parties have also agreed to consider other methodologies for evaluating indicators and trends in the SPRNCA reaches as data, modeling, and science in the area continue to evolve and improve, and have identified a consensus-based approach to considering potential alternative metrics and/or changes in methodology, which may be informed by input from the technical advisors to the Upper San Pedro Partnership, USGS, and such other technical experts as the Adaptive Management Committee may determine to be appropriate and necessary.

A metric will be separately needed to define wetland site health in relation to hydrologic conditions. The BLM is in the process of establishing the quantitative thresholds that define wetland health; it is not included in the current document.

¹ It is important to note that the parties are not adopting the “wet,” “intermediate” or “dry” designations developed in Leenhouts et al. (2006) as the metric for evaluating or triggering actions under this Plan, but rather intend to evaluate the projected trend in riparian condition class within each SPRNCA reach in comparison to current conditions. Similarly, the specific conditions of the SPRNCA reaches that were observed in the Leenhouts et al. (2006) study are not being adopted by the parties as a baseline, since the management actions being undertaken in the MOU are designed to influence an inherently dynamic and complex hydrological and ecological system that (as noted above) is continuing to change in response to historic and current groundwater withdrawals, riparian vegetation needs, variability in recharge rates, changing climate, and other factors.

A.2.1. SPRNCA Reaches

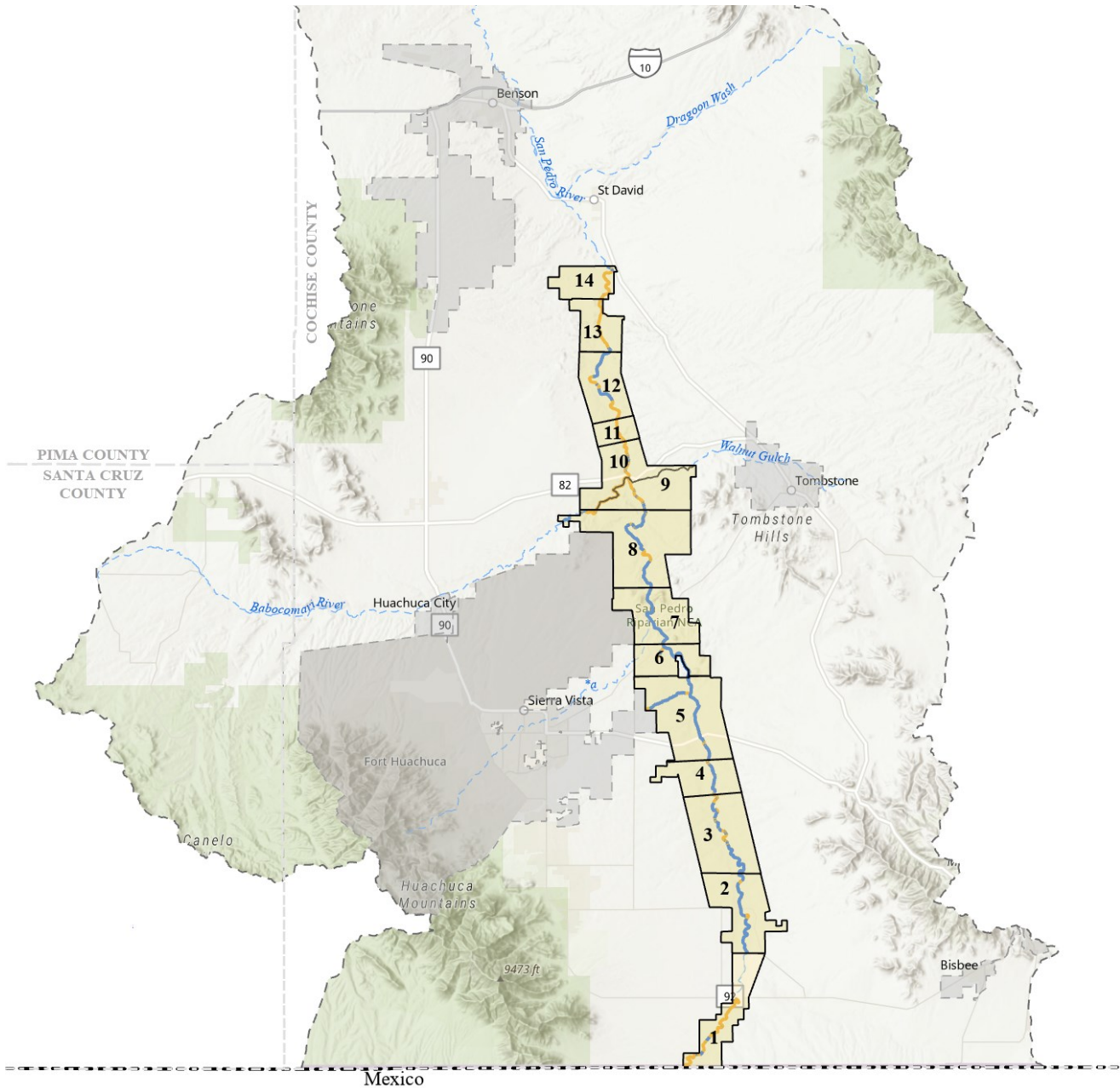


Figure 1: Delineated SPRNCA Reaches (adapted from Leenhouts et al., 2006).

This Plan is also adopting three “riparian condition classes” that correspond to the approximate ranges for observed surface flow permanence, mean and maximum depth to groundwater in the floodplain, and expected variation in groundwater levels through the year that were identified in that study (with Class 3 conditions corresponding to riparian areas with relatively permanent surface flow and shallower groundwater that are most conducive to supporting healthy riparian vegetation on one end of the range, and Class 1 conditions corresponding to areas with limited or no surface flow and deeper groundwater that cannot readily support healthy vegetation on

the other end of the range), consistent with the methodology proposed by Leenhouts et al. (2006). The quantitative ranges of values for surface water and groundwater that will initially be used to define these condition classes for purposes of this Plan will be based on empirical data collected within the SPRNCA and are defined as shown below.

Riparian Condition Class	Surface flow permanence	Mean flood-plain ground-water depth (m)	Maximum flood-plain groundwater depth (m)	Expected annual ground-water fluctuation (m)
Class 3	Perennial	1.6 ± 0.5	1.7 ± 0.5	0.3 ± 0.0
Class 2	Intermittent-wet	2.5 ± 0.6	3.0 ± 0.9	0.9 ± 0.7
Class 1	Intermittent - dry	2.5	3.5	1.8

Table 1: Riparian condition class thresholds (adapted from Leenhouts et al., 2006).²

A.2.2. Monitoring to Assess Current Status of Riparian Health and Regional Aquifer Conditions

Since localized impacts to the hydrology of the system can be highly variable from SPRNCA Reach to SPRNCA Reach, monitoring to determine the current status of riparian health should be spatially comprehensive and include all 14 SPRNCA Reaches that are addressed by this Plan. The data required to determine current status of Riparian Health include, but are not limited to:

- Near-stream alluvial-aquifer water levels
- Streamflow permanence
- Riparian vegetation data

Evaluation of current conditions is conceptually simple, requiring only to repeat as closely as possible the hydrologic monitoring and subsequent analysis originally undertaken by Leenhouts and Stromberg as detailed in Leenhouts and others (2006), Chapters B and C. Most wells monitored as part of the 2002-2003 effort described in that publication continue to be monitored quarterly by the USGS currently. In order to obtain accurate groundwater fluctuation data, many of these wells would also need to be outfitted with continuously recording pressure transducers to obtain continuous water-level data. Continuous (i.e., hourly to daily) water-level monitoring is necessary to accurately determine annual water level fluctuations and mean and maximum dry-season depth to water.

In developing this Plan, the parties recognize that local and regional stakeholders do not have jurisdiction or authority over the land within the SPRNCA Reaches, and that management actions undertaken within the SPRNCA Reaches are largely, if not exclusively, within BLM control. However, management actions undertaken

² The values presented are intended to reflect the hydrologic conditions that would be expected to correspond to particular riparian conditions, based on the Leenhouts et al. (2006) study. The parties intend to update these values to reflect better understanding of the hydrologic values associated with these riparian condition classes to incorporate new information as Plan implementation proceeds. Because there is some potential overlap between condition classes, the Adaptive Management Committee will determine how best to characterize the current or modeled future condition of each SPRNCA Reach at the time of each assessment. In assessing surface flow permanence, the Parties acknowledge that it is presently difficult to monitor surface flow permanence across all of the SPRNCA Reaches, such that the assessment of permanence will be somewhat subjective based on available data in each Reach. Permanence categories refer to Table 16 in the Leenhouts et al. (2006) study.

outside of the SPRNCA Reaches that maintain, restore or improve regional aquifer conditions may also support one or more SPRNCA Reaches and advance MOU Objectives. Additional data required to determine current status of regional aquifer conditions include, but are not limited to:

- USGS Regional Well Data (including horizontal gradients and trends/fluctuations);
- Aquifer Storage Change Measured with Microgravity;
- Annual Water Budget Balance;
- Arizona Department of Water Resources Well Sweep Data;
- Cochise Conservation & Recharge Network Monitoring data;
- Data on precluded groundwater pumping due to conservation easements, regulatory restrictions and other measures implemented in the region to decrease consumptive water uses.

A.2.3. Modeling of Projected Trends for Riparian Health

Assessments of the current status of riparian health and regional aquifer conditions as described in A.2.2 above will provide a comprehensive snapshot of the riparian conditions at the time that each evaluation is undertaken pursuant to this Plan. However, because the parties are seeking to guide planned and proposed management actions in the context of a dynamic system, the parties will rely on an evaluation of recent and projected *trends* for riparian health rather than an evaluation of the current status against any particular historic baseline or other arbitrary state. Given the inherently lagged response time of groundwater systems to groundwater pumping impacts -- as well as to managed and natural recharge -- the Plan will utilize and evaluate both *current* riparian health condition classes (the “current status”), and *projected* riparian health condition classes for the next 10 years (the “projected trends”) in order to (i) anticipate changing conditions over time, and (ii) inform management measures which may be necessary to maintain or change trend status.

Projected trends must be modeled based on the future water uses anticipated, planned management measures, and current climate projections. Empirical field data should be continuously collected over time to refine and calibrate model predictions as both hydrological and ecological conditions will continuously change. However, because neither hydrological nor ecological conditions are likely to dramatically change from one year to the next, the reevaluation of both status and projected trends pursuant to the Plan will be considered at periodic intervals (described further below), but may also be undertaken more frequently based on the availability of new data or in the event of proposed or actual changes in water management plans and activities relevant to the Plan.

To provide this capacity for evaluation of projected trends, a highly calibrated, integrated groundwater-surface water model will be used in support of the SPRNCA Cooperative Plan. Models of this type can be utilized to predict these future riparian health trends with meaningful accuracy, provided sufficient data are available. The role of the model will be to incorporate not only groundwater and surface water changes in response to basin-wide pumping, recharge, and discharge, but also to include effects of land use, vegetation, and climate – each as may be influenced by planned management actions and activities – as inputs to the extent feasible.

The model will be used to generate outputs of higher precision than those currently available from the Pool and Dickinson (2006) MODFLOW model; cover the entire length of the SPRNCA (the Pool and Dickinson 2006 model covers only the portion of the SPRNCA within the Sierra Vista Subwatershed); and should utilize many of the surface-water components available in a GSFLOW model such as a more refined Precipitation Runoff Modeling System and daily time steps.

The integrated model will be developed with an appropriate spatial and temporal scale for evaluating the short- and long-term hydrologic responses in the riparian zone, and it will be updated periodically to include:

- New or proposed land use proposals, land management initiatives, or major water-use, export, or importation proposals, and/or aquifer recharge projects inside or outside of the SPRNCA
- The latest Intergovernmental Panel on Climate Change model predictions
- Ongoing refinement and calibration of model parameters using the following empirical data including:
 - Regional groundwater levels
 - Aquifer storage change measured with microgravity
 - Groundwater budget balance (including updated pumping information)
 - Near-stream alluvial aquifer water levels
 - Streamflow permanence
 - Streamflow at USGS streamgages on the San Pedro and Babocomari
 - Annual wet dry mapping data
 - Spring discharge
 - Precipitation, temperature, and evapotranspiration (ET)
 - Vegetation mapping

Based on actual field data, the parties expect that a calibrated integrated model can be used to predict future trends in the riparian condition classes described above within a reasonable range of uncertainty associated with the model input and calibration. Additionally, annual wet-dry mapping would serve to check/validate the model's calibration for the update period. The model would provide valuable information on tributary inflows to the SPRNCA for all un-gaged tributaries as well as bank storage and ET from saturated and unsaturated zones, canopy, bare ground, and open water.³

To evaluate the “projected trend” for each SPRNCA Reach, the differences between the current conditions and the “projected 10-year trend” will be compared. An evaluation will be conducted every year for the first two years to evaluate changes and performance of the management and/or monitoring actions in place. Thereafter, at approximately ten-year intervals, or on a more frequent basis at the request of any party, the current status and subsequent 10-year projections would be compared to the “projected trend” from the previous evaluation.

Pursuant to the terms of the MOU, the parties intend to delegate a number of technical support functions related to monitoring and projecting trends for riparian health and will determine and select both model(s) that will be used for this purpose, together with the schedule for updating model inputs, collecting data, conducting modeling analyses through the MOU Adaptive Management Committee.

A.2.4. Integration of Current Status and Projected Trends for Adaptive Management

As noted above, given the lagged responses of groundwater systems, for purposes of this Plan the parties will rely on both an assessment of the current condition of each SPRNCA Reach and the trends indicated by a comparison of current conditions and model-projected future conditions to ongoing monitoring and water management needs.

The matrix shown below in Table 2 describes the framework that the MOU parties will use to guide the interpretation of monitoring data and the projection of future conditions, by comparing the most recent evaluation of riparian condition classes for each SPRNCA Reach against the modeled projection of future trend for that specific reach. The corresponding responses described in the matrix will allow for flexibility in reassessing or

³ At the time of the development of this Plan, the parties anticipate using a soon-to-be available model, currently being developed by Fort Huachuca, to conduct the initial analysis of projected trends of riparian health under the MOU. However, the parties may consider replacing or supplementing this model as Plan implementation continues based on information and modeling developed in parallel by USGS, which is expected to cover a broader geographic area. As described in the MOU, the parties will, through consensus of the Adaptive Management Committee, agree to the specific model that will be used for the analysis of projected trends under this Plan.

revising management actions in response to changing conditions, while providing a general framework to guide necessary and timely actions to address developing trends. Each of the 14 SPRNCA Reaches will be evaluated separately.

MODEL TREND PER REACH							
	<i>Significant Improvement</i>	<i>Improving</i>	<i>Minimal Improvement / No Change</i>	<i>Minimal Decline</i>	<i>Decline</i>	<i>Significant Decline</i>	
	<i>Model projects positive change in class within period</i>	<i>Model projects positive trend that could change class</i>	<i>Model projects no change or small positive trend within normal variation</i>	<i>Model projects small negative trend within normal variation</i>	<i>Model projects negative trend that could change class</i>	<i>Model projects negative change in class within period</i>	
CURRENT CLASS	3	MOU Objectives satisfied ⁴	MOU Objectives satisfied	MOU Objectives satisfied	MOU Objectives satisfied, but potential additional monitoring and management options may be considered	Additional monitoring and management options will be considered	Additional monitoring and management options will be considered
	2	MOU Objectives satisfied	MOU Objectives satisfied	MOU Objectives may be satisfied, but potential additional monitoring and management options may be considered	Potential additional monitoring and management options should be considered	Additional monitoring and management options will be considered	Additional monitoring and action required
	1	MOU Objectives satisfied	MOU Objectives may be satisfied, but potential additional monitoring and management options may be considered	Potential additional monitoring and management options should be considered	Potential additional monitoring and management options will be considered	Additional monitoring and action required	Additional monitoring and action required

Table 2: Adaptive management responses to monitoring and modeling outcomes

As noted above, the parties acknowledge that management actions undertaken outside of the SPRNCA Reaches that maintain, restore or improve regional aquifer conditions, including but not limited to recharge projects and measures that reduce consumptive water use, will support SPRNCA Reaches or advance the MOU Objectives.

A.3. Timing, Location, and Estimated Costs of Data Collection

⁴ The Parties agree that satisfaction of MOU Objectives in any particular SPRNCA Reach does not preclude the Adaptive Management Committee from evaluating and engaging in further monitoring or management decisions.

The data necessary for analyzing current riparian condition classes and maintaining relevant model inputs and calibration are described in detail below. The timeframe identifies the necessary frequency of monitoring, and in the case of continuous measurements, the field visits required.

Pursuant to the terms of the MOU, the parties intend to delegate technical support functions and determine a schedule for collecting and reporting data through action of the Adaptive Management Committee.

Data collection includes the activities listed in the following table, listed by sustainability indicator categorized by:

- (1) Indicators used for model input and calibration;
- (2) Indicators used for both model input and current status of riparian health;
- (3) Additional data required for model input.

Data Collection

Sustainability Indicators (USGS) [1]	Description of Data Collection Activity Related to Model Parameter [2]	Responsible Party	Related RMP Objectives	Costs (where known)
(1) Indicators Used for Model Input and Calibration				
Regional Groundwater Levels	37 wells monitored by USGS as part of the Sustainability Indicators (Gungle et al., 2016) and 10 additional wells monitored by BLM. The total currently is 47 wells/well points. They are visited quarterly for data collection. All water levels are QA/QC'd following specific, documented USGS protocols including the nature of the measurements (tape calibration, method of measurement and measuring point, periodic vertical verification of measuring point, field check, transducer reset in the field at continuous well location, then back at the office, data analysis, data loading, data discussion for each well site, data adjustment for transducer-based data, and a 3-step data approval process that results in the water level data being loaded and shown as "approved" on the publicly accessible USGS National Water Information System (NWIS) data base. Data type for model parameter: groundwater elevations; numeric. Data collection is continuous; quarterly. Data location: NWIS Water Data.	BLM; USGS	ob-WAT-3, ob-VEG-RIP-1, ob-VEG-RIP-2	\$635 per well for USGS discrete sampling (37) for total of \$23,495, \$750 per site BLM estimate (10 sites) – Total \$7,500
Aquifer Storage change Measured with Microgravity	USGS Arizona Water Science Center gravity data archive. Data type for model parameter: numeric, in microgals.	USGS	ob-WAT-3, ob-VEG-RIP-1, ob-VEG-RIP-2	
Groundwater Budget Balance	Pumping data from USGS water use group (residential/commercial/irrigation), rural exempt pumping and industrial pumping are calculated as a function of increase in relevant population groups (sand and gravel mining), golf course irrigation, and stock tank pumping (Natural Resource Conservation District);	USGS	ob-WAT-3	
	Municipal recharge data from jurisdictions of Sierra Vista, Ft. Huachuca, Tombstone, and Bisbee;	Fort; Sierra Vista; County	ob-WAT-3	
	Detention basin recharge from Ft. Huachuca and Sierra Vista (latter value can be derived from precipitation using ARS regression equation);	Fort; Sierra Vista	ob-WAT-3	
	Mesquite and tamarisk treatment, if any, from BLM;	BLM	ob-WILD-2, ob-VEG-RIP-1, ob-VEG-RIP-2, ob-VEG-RIP-5, ob-VEG-All-1, ob-VEG-All-2, ob-WAT-3	

Data Collection

Sustainability Indicators (USGS) [1]	Description of Data Collection Activity Related to Model Parameter [2]	Responsible Party	Related RMP Objectives	Costs (where known)
	Incidental recharge is derived as a function of pumping deliveries and irrigation volumes;	Fort; Sierra Vista; County	ob-WAT-3	
	Urban enhanced recharge has been derived as a function of impervious surface in the subwatershed. [3]	Sierra Vista; County	ob-WAT-3	

(2) Indicators Used for Both Model Input and Current Status of Riparian Health				
Near-Stream Alluvial Aquifer Water Levels	39 wells/well points monitored as part of the Sustainability Indicators (Gungle et al., 2016) and 9 wells/well points as part of BLM’s FRWR monitoring. With one overlap (COTBLM), the total currently is 47 wells/well points. In order to compare results accurately with Stromberg et al (2006) some wells will need to be brought out of retirement: 6 in the Sierra Vista Subwatershed and 5 more in the reaches north of the Tombstone gaging station (Contention, Summers, and St. David biohydrology sites from Leenhouts et al., 2006). Current monitoring includes continuous water level measurements using pressure transducers at 14 of the 39 wells referred to in the previous paragraph. They are visited quarterly for data collection and calibration. [4] Data type for model parameter: groundwater elevations, numeric. Data collection is continuous, visited quarterly. Data location: NWIS Water Data.	USGS	ob-WAT-2, ob-VEG-RIP-1, ob-VEG-RIP-2	\$1,600 per well per year – with 42 wells annual cost is \$67,200

Data Collection

Sustainability Indicators (USGS) [1]	Description of Data Collection Activity Related to Model Parameter [2]	Responsible Party	Related RMP Objectives	Costs (where known)
Streamflow Permanence	<p>According to Leenhouts et al (2006), streamflow permanence is the best indicator for near-stream herbaceous vegetation. To quantify this Leenhouts et al (2006) used in-situ temperature sensors throughout the stream reaches. This is a considerable undertaking to repeat. Data from streamflow permanence cameras and USGS gages gives a general idea but not the spatial resolution required. The best way to monitor this indicator is still under consideration. Data collection would ideally be continuous.</p> <p>Gage data RE: flow present (wet) or absent (dry or ponded) for Palominas, Lewis Springs stage recorder, Charleston, Tombstone, AND Photos of streamflow every 12 hrs converted to wet (flowing or ponded) and dry data. (Note that data types are inconsistent with regard to ponded, not flowing data—"not flowing" is problematic to define via photography; it could be possible but difficult to determine "ponded but not flowing" from stage data. Charleston is the primary site with a deep pool by the gage, but has only been not-flowing for a short period in 2005.)</p>	USGS	ob-WAT-2, ob-VEG-RIP-1, ob-VEG-RIP-2, ob-Veg-ALL-2, ob-WILD-2, ob-WILD-5	
Streamflow at USGS streamgages on the San Pedro and Babocomari	3 mainstem gages (Palominas, Charleston, Tombstone) and one on the Babocomari River at SPRNCA boundary (aka Lower Babocomari). There is also a stage recorder at the Lewis Springs research site (no discharge calculated). Stream gages record continuous data. They are visited quarterly by the USGS following their stream gage protocols. The data is publicly available on the NWIS database. Data collection is continuous.	USGS	ob-WAT-2, ob-VEG-RIP-1, ob-VEG-RIP-2, ob-Veg-ALL-2, ob-WILD-2, ob-WILD-5	FY2020 annual cost is between \$19,000 and \$20,000 per gage X 4 (Palominas, Charleston, Tombstone, Babocomari) = \$78,400
Annual Wet Dry Mapping	GPS data collected on the 3rd week of June each year from entire San Pedro River in subwatershed, Babocomari River, Curry Draw (Environmental Operations Park to river), Coyote Wash (Escapule Rd. to River). Data displayed in an ArcGIS environment of wetted lengths of stream.	TNC	ob-WAT-2, ob-WAT-3, ob-Veg-ALL-1, ob-Veg-ALL-2, ob-WILD-1	

Data Collection

Sustainability Indicators (USGS) [1]	Description of Data Collection Activity Related to Model Parameter [2]	Responsible Party	Related RMP Objectives	Costs (where known)
Springs Discharge	Current monitoring includes spring discharge measurements at 5 locations in SPRNCA by USGS (Kolbe, Murray, Horsethief, Moson, and N. Lewis). Discharge is collected using flumes, weirs, velocity meters, or volumetrically (bucket). BLM monitors wetland water level fluctuations at the St. David Cienega and Lil Joe wetlands. Springs to be added (North of SV SW) – Frog Spring, Ben Spring, Dunlevy, and Curtis Artesian Well. Data type for model parameter: Discharge data; numeric in ft ³ /s. Data collection is quarterly. Data available via NWIS (Automated Data Processing System); National Climate Center; City of Sierra Vista Annual Report.	USGS	ob-WAT-4, ob-VEG-RIP-1, ob-VEG-RIP-2, ob-Veg-ALL-2, ob-WILD-2, ob-WILD-5	\$1,280 per site for quarterly measurements – Current (5) cost is \$6400 year, Springs to the North (4) will add \$5,120, for a total of \$11,520

Data Collection

Additional Data	Description of Data Collection Activity Related to Model Parameter [1/]	Responsible Party	Related RMP Objectives	Costs
(3) Additional Data Required for Model Input				
<p>Precipitation, Temperature, and ET</p>	<p>4 station average precipitation (used in sustainability report) was based on National Climate Data Center precipitation data. However, those data have problems and require filling in gaps based on relationships to other stations for some months. 4 station individual plots with 4 station average all on same plot is how subwatershed precipitation has been displayed in 321 Reports and sustainability report.</p> <p>U.S. Dept. of Agriculture, Agricultural Research Service maintains a 100+ rain gage network in Walnut Gulch subwatershed of the Sierra Vista Subwatershed as well as additional precipitation gages across the Sierra Vista Subwatershed.</p> <p>Data for model parameter: monthly precipitation totals.</p>	<p>USDA/ARS (precipitation and ET)</p>	<p>ob-WAT-3, ob-VEG-RIP-2</p>	
<p>Vegetation Mapping</p>	<p>As described in Leenhouts et al (2006), the bio-hydrology transects encompass 9 total indicators. Protocols involve 20m riparian belt transects and in-channel herbaceous quadrats. Most of the identified 14 reaches have several bio-hydrology sites with an original survey of 26 sites. Data collection is every 5 years.</p>	<p>BLM</p>	<p>ob-WAT-2, ob-WAT-3, ob-VEG-RIP-1, ob-VEG-RIP-2, ob-Veg-ALL-2, ob-WILD-2, ob-WILD-5</p>	<p>\$70,000</p>

Notes:

[1/] For purposes of the SPRNCA Cooperative Plan, water quality indicators not included at this time, only those that address water availability.

Horizontal gradients, near-stream vertical gradients, fluctuation of alluvial aquifer, were not included for model input/calibration since they are derived from the same data as other indicators.

[2/] Data Collection Activities as of March 2021.

[3/] This value has always been somewhat speculative and should be derived in part as a function of watershed precipitation, post- and pre-development runoff.

[4/] Cost estimates are subject to change, likely increase, in future FYs; these numbers are for ballpark estimating possible monitoring costs and should not be construed as an offer to render services. USGS currently charges cooperators \$635 per well for monitoring wells quarterly. Continuous wells outfitted with a pressure transducer cost \$1,600 per well, downloaded and corrected quarterly. All water levels are QA/QC'd following specific, documented USGS protocols including the nature of the measurements (tape calibration, method of measurement and measuring point, periodic vertical verification of measuring point, field check, transducer reset in the field at continuous well location, then back at the office, data analysis, data loading, data discussion for each well site, data adjustment for transducer-based data, and a 3-step data approval process that results in the water level data being loaded and shown as "approved" on the publicly accessible USGS NWIS data base). Cost estimates for other monitoring (e.g. Riparian Vegetation) is provided as an estimate by BLM and should be considered with an equal (perhaps greater) amount of uncertainty.

A.4. Database Development and Reporting

Datasets collected from various hydrologic monitoring efforts ongoing in the region are in many cases stored and reported by agencies and organizations and in a variety of formats. To make the wealth of hydrologic information more readily accessible and useful, the City of Sierra Vista and the Upper San Pedro Partnership applied for and were awarded a U.S. Bureau of Reclamation WaterSMART Applied Science grant in early 2020 to develop a web-based hydrologic information portal for the Upper San Pedro Basin (the WHIP). Among its other functions, the WHIP will ensure the ready and timely availability of future Upper San Pedro Basin monitoring data via a report-out template including information needed by water managers. The project timeline includes a 7-month planning phase, a 15-month development phase, and an overlapping 5-month dissemination phase.

The parties will continue to engage in the WHIP planning and development processes as appropriate to encourage functionality be built into the WHIP to meet the database storage and reporting needs of this Plan, including reporting on indicators described in this Plan.

Until the WHIP is implemented, the parties will store and report data collected pursuant to section A.5 according to the existing standards and practices of the Upper San Pedro Partnership and will work collaboratively to provide any of the other SPRNCA Cooperative Plan party any data or information needed to implement this Plan.

A.5. Ongoing and Planned Management Actions

The parties have already undertaken or are currently undertaking the following activities, which are intended to have beneficial effects related to the MOU Objectives, each as described in the tables below. Pursuant to the MOU, each party will continue to undertake and implement these listed activities, and will coordinate planning, funding and implementation of the activities with the SPRNCA Cooperative Plan parties as needed.

Management Actions

Action / Project Name	Project Lead	Description / Purpose	RMP Goals/Objectives Supported by Project	Planned Actions
SPRNCA RMP	BLM	Soils & Watershed Management - management actions, activities, and allowable uses- Recharge enhancements within ephemeral tributaries that slow and/or recharge accelerated runoff from developed/urbanized areas will ensure a natural flood flow regime and help protect and enhance flood flows, groundwater levels and baseflows. Restoration of a natural flood flow regime within relatively undeveloped/non-urbanized subwatersheds and ephemeral tributaries will ensure that mainstem flood flows remain intact.	ama-SOIL-3; Ob-WAT-3	Improve watershed health and prioritize treatments for recharge enhancements in ephemeral tributaries. Monitor groundwater levels near recharge enhancements and modify size, location, and/or type of enhancement to achieve rising or stable groundwater levels
SPRNCA RMP	BLM	Soils & Watershed Management - management actions, activities, and allowable uses - Additional sediment transport, hydraulic, and ecological assessments to inform floodplain management options related to geomorphology within SPRNCA could benefit baseflows, groundwater conditions and flood flows over the long term, as well as forest recruitment.	ama-SOIL-4; Ob-WAT-3	Assess the level of departure of current river geomorphology and function from its potential for each reach. Where assessment indicates that channel function can be enhanced through the gradual implementation of low impact structural and nonstructural approaches, design and implement projects, where feasible. Monitor changes in key parameters.
SPRNCA RMP	BLM	Soils & Watershed Management - management actions, activities, and allowable uses - Surface run-on from surrounding upland areas onto abandoned ag fields near the river has been obstructed by historic berms and stormwater diversions constructed for agricultural operations. Earthwork that facilitates movement of sheet flow from the upland areas to near stream fields and ephemeral drainages would benefit infiltration and groundwater recharge	ama-SOIL-5; Ob-WAT-3	Assess the man-made structures from historical land uses (e.g., agricultural dikes and berms, railroad grades, and ditches and diversions) for hydrologic function, determine their level of impairment, and rehabilitate (either dismantle or alter) as necessary.
SPRNCA RMP	BLM	Soils & Watershed Management - management actions, activities, and allowable uses - Restoring natural drainage patterns and watershed function would benefit flood flows, baseflows, and groundwater levels.	ama-SOIL-6 ; Ob-WAT-3	Modify all routes affecting watershed health and function, as necessary to restore watershed function and long-term health
SPRNCA RMP	BLM	Water Management - management actions, activities, and allowable uses - A spatially-explicit assessment of groundwater levels and baseflows within SPRNCA, that compares the benefits of simulated groundwater protection and/or recharge options, can be used to prioritize the most effective groundwater management strategies to meet the SPRNCA’s current and future water needs.	ama-WAT-1	Review and assess water needs for resources managed on the SPRNCA and acquire and perfect new water rights as deemed necessary for management purposes
SPRNCA RMP	BLM	Water Management - management actions, activities, and allowable uses - All authorized pumping within SPRNCA reduces groundwater storage and levels by the amount pumped.	ama-WAT-2; Ob-WAT-3	Design any pumping of groundwater for BLM-authorized actions to reduce impacts on base flows; this could include putting

Management Actions

Action / Project Name	Project Lead	Description / Purpose	RMP Goals/Objectives Supported by Project	Planned Actions
		Withdrawals for all purposes can be minimized through strict water conservation measures.		floats in troughs and seasonally restricting groundwater pumping
SPRNCA RMP	BLM	Water Management - management actions, activities, and allowable uses - No new authorizations for additional land uses or associated groundwater pumping within the SPRNCA will help to protect and enhance groundwater levels.	ama-WAT-3; Ob-WAT-3	Do not approve land use authorizations (realty actions) involving additional groundwater pumping on the SPRNCA, subject to valid existing rights
SPRNCA RMP	BLM	Water Management - management actions, activities, and allowable uses - The development of an effective SPRNCA groundwater monitoring program within SPRNCA, capable of quantifying the current status and ongoing trends of groundwater levels, will be essential to inform land and water management options over time. The need for any emergency habitat augmentation measures to protect baseflows or groundwater levels can be reduced through ongoing land and water management activities, however, when absolutely necessary, they can be informed by predictive hydrologic modeling to optimize the benefits and minimize any secondary unintended consequences.	ama-WAT-4	Assess existing wells on the SPRNCA for use as monitoring wells, administrative use, wildlife use (drinking and habitat), habitat restoration (for maintaining a limited number of off-channel aquatic habitats for threatened and endangered species recovery), livestock use, emergency habitat augmentation, and other potential uses.
SPRNCA RMP	BLM	Vegetation Communities - management actions, activities, and allowable uses - Eradication/reduction of undesirable, non-native phreatophytes will reduce consumptive groundwater loss to ET, and benefit groundwater levels. Reduction of mesquite encroachment within floodplain (sacaton) grasslands may also reduce ET and benefit groundwater levels.	ama-VEG-ALL-1; Ob-WAT-3,	Use combinations of biological (targeted livestock grazing, insects, etc.), mechanical, prescribed fire, and chemical management to suppress, control, and/or eliminate invasive species/noxious weeds
SPRNCA RMP	BLM	Vegetation Communities - management actions, activities, and allowable uses - Proper functioning condition of the riparian corridor will enhance infiltration of floodwaters into stable, vegetated streambanks and floodplain terraces	ama-VEG-RIP-1; Ob-WAT-3	Restore and maintain riparian function.
Sierra Vista Surface Water Plan	City of Sierra Vista	The City of Sierra Vista’s Surface Water Plan, originally implemented in 1984, establishes natural drainage maintenance corridors (NDMCs) throughout the City. NDMCs have a variety of benefits, but as related to watershed management, the NDMCs help to protect natural flow characteristics, which in turn helps to reduce erosion and sediment transport to downstream areas, including the San Pedro.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-2	
Artificial Turf	City of Sierra Vista	Utilize artificial turf where feasible to limit groundwater use for irrigation. Two City soccer complexes were recently converted to artificial turf. Annual water savings are estimated at 59 ac-ft.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-3	

Management Actions

Action / Project Name	Project Lead	Description / Purpose	RMP Goals/Objectives Supported by Project	Planned Actions
		Artificial turf reduces the need for irrigation and thus groundwater pumping.		
Noxious Weeds Treatment	City of Sierra Vista	The City of Sierra Vista treats approximately 212 acres annually for noxious weeds. Targeted weed spraying and removal helps to control the spread of noxious weeds. These weeds prevent the growth of native plants and create a heightened fire risk, leading also to an increase in accelerated runoff and erosion.	ob-SOIL-2; g-WAT-1; g-VEG-ALL-4	
Wash Maintenance	City of Sierra Vista	The City of Sierra Vista maintains about 318 ac-ft of washes annually. The purpose of the program is both to thin vegetation to healthy levels and maintain natural drainage characteristics. Regular wash maintenance reduces fuel in the wildland urban interface, which in turn changes fire behavior characteristics including reduced flame lengths, slower rates of spread, reduced fire intensity levels, and reduced crown fire potential. The reduced wildfire risk helps preclude accelerated runoff and erosion.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-5	
Development Design Standards	City of Sierra Vista	The City of Sierra Vista was among the nation’s first to adopt EPA WaterSense standards for development, and is presently working with developers to continuously implement those requirements. The EPA reports a saving of approximately 50,000 gallons per four person household annually over traditionally built homes, which equates to reductions in water consumption of more than 1,000 acre-feet annually in a development of approximately 7,000 homes.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-6	
Cochise Water Project	City of Sierra Vista	The City of Sierra Vista participated in the Cochise Water Project, which succeeded during its 6 year program duration, in reducing community water use by approximately 400 acre-feet annually with cumulative savings through 2021 of approximately 3,000 acre-feet.--. Re-funding the Cochise Water Project could aid surrounding communities in reducing their gallons per day per capita (“GPCD”) water consumption, which benefits the Sierra Vista Subwatershed, including the SPRNCA.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-7	
Management of State Lands	City of Sierra Vista	Work with the Arizona State Land Department on the management of state lands within Sierra Vista city limits. Approximately four years ago, a Forest Service crew performed vegetation trimming and removal on hundreds of acres of state lands located within and adjacent to the City of Sierra Vista. It is hoped this work will be repeated in the future. This work would promote healthy plant growth and thereby minimize wild fire extent and intensity and precluding accelerated runoff and erosion.	ob-SOIL-2; g-WAT-1; g-VEG-ALL-9	

Management Actions

Action / Project Name	Project Lead	Description / Purpose	RMP Goals/Objectives Supported by Project	Planned Actions
Environmental Operations Park	City of Sierra Vista	<p>Continue operation of the Environmental Operations Park (EOP), which currently recharges about 2700 acre-feet per year between the wetlands and the recharge basins. The positive benefits of the EOP in sustaining and enhancing base flow of the San Pedro are well documented and acknowledged by diverse stakeholders.</p> <p>Also exploring conveying untreated sewage from a new development to EOP for treatment and increasing capacity of EOP treatment facilities to accommodate additional sewage.</p> <p>The feasibility of shifting some of the flow to Riverstone is currently being explored, as described below.</p>	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	<ol style="list-style-type: none"> 1. Final engineering and design for sewage conveyance pipeline to EOP and effluent pipeline to Riverstone 2. Secure ROW for sewage pipeline to EOP and effluent pipeline to Riverstone 3. Secure an agreement between Castle and Cook and Sierra Vista for sewage conveyance/treatment and a separate effluent agreement between Cochise County and Sierra Vista for delivery of effluent to Riverstone 4. Fund construction of both conveyance pipelines and expansion of treatment facilities at EOP as needed 5. Permitting of two pipelines 6. Complete construction of two pipelines 7. Develop EOP monitoring plan 8. Operations, Maintenance & Performance Monitoring of EOP recharge facility, sewage and effluent pipelines
Sierra Vista Sub-Watershed Water Conservation and Management Policy Plan	Cochise County	Prohibits any increases in residential densities through upzonings where new development would result in pumping within two miles of the SPRNCA. Precluding potential density increases in the Sierra Vista Sub-watershed within 2 miles of SPRNCA will decrease future potential groundwater pumping.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	
Cochise County Subdivision Regulations	Cochise County	Subdivision regulations have an option for conservation subdivisions that require a 50% set-aside through conservation easements, including drainage corridors (e.g., Kings Ranch). Leaving drainage corridors intact and unfragmented allows/provides for the movement of wildlife between the mountains and SPRNCA, as well as maintains natural flood flows to the river.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	
Conservation & Watershed Health programs	Cochise County	Continue to work with county residents, businesses, and partners on developing solutions that will slow accelerated flows, enhance watershed health, build soil moisture capacity, control erosion and sedimentation. In addition, the county will continue to utilize some of its properties for additional land treatments, recreational and educational access and seek to create linkages with the SPRNCA.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-8	

Management Actions

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		Activities will ultimately foster overall watershed health including tributaries and sheetflow that have a nexus with SPRNCA.		
Babocomari	Cochise County	Preclude near-stream pumping on the Babocomari and provide a future location for near-stream recharge if source water becomes available.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-10	1. Baseline Monitoring of groundwater
Coyote Wash Urban Enhanced Runoff (UER)	Cochise County	Increase the infiltration of urban enhanced runoff in Coyote Wash to support the base flows of the SPRNCA without alteration of the natural flood flow regime.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	<ol style="list-style-type: none"> 1. Baseline Monitoring of surface water and groundwater 2. Final engineering and project design 3. Secure assurances for use of urban enhanced runoff for recharge from surface water users 4. Secure funding for construction 5. Permitting 6. Complete Construction 7. Complete Coyote Wash Monitoring plan 8. Operations, Maintenance & Performance Monitoring
Riverstone Effluent Recharge	Cochise County	Recharge treated effluent delivered from the EOP by City of Sierra Vista in rapid infiltration basins (acre-feet per year TBD), and preclude future near-stream pumping (150 acre-feet per year)	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	<ol style="list-style-type: none"> 1. Baseline Monitoring 2. Secure Effluent Agreement between County and Sierra Vista 3. Secure Right of Way for conveyance between EOP and recharge site 4. Technical studies & final design 5. Permitting for rapid infiltration basins 6. Complete Construction 7. Develop Riverstone monitoring plan 8. Operations, Maintenance & Performance Monitoring
Three Canyons	Cochise County	Permanently retire approximately 2592 acre-feet per year historic near-stream pumping and preclude future pumping 36 acre feet per year)	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	<ol style="list-style-type: none"> 1. Develop Three Canyons monitoring plan 2. Operations, Maintenance & Performance Monitoring
Palominas Flood Control and Stormwater Recharge Project	Cochise County	Capture and convey sheetflow from Schoolhouse Wash Watershed to a constructed channel with infiltration enhancements	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1; g-VEG-RIP-1	<ol style="list-style-type: none"> 1. Develop Palominas monitoring plan 2. Operations, Maintenance, & Performance Monitoring

Management Actions

Action / Project Name	Project Lead	Description / Purpose	RMP Goals/Objectives Supported by Project	Planned Actions
Horseshoe Draw Sediment Control and Stormwater Recharge Project	Cochise County	Purpose: Capture accelerated runoff from Horseshoe Draw in a detention basin to decrease sedimentation and increase infiltration and recharge	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1; g-VEG-RIP-1	<ol style="list-style-type: none"> 1. Develop Horseshoe monitoring plan 2. Operations, Maintenance, & Performance Monitoring
Bisbee Effluent Recharge Project	Cochise County	Convey Bisbee's treated effluent from the San Jose Wastewater Treatment Plant to a near-stream infiltration basin for recharge (minimum of 200 acre-feet per year)	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1; g-VEG-RIP-1	<ol style="list-style-type: none"> 1. Exercise current option for 25-year effluent agreement between City of Bisbee and Cochise County 2. secure ROW from San Jose WWTP to recharge basin 3. acquire land for recharge basin facility. 4. Technical Studies & Final Design of both pipeline and infiltration basin 5. Baseline Monitoring 6. Permitting 7. Complete construction 8. Develop Bisbee Effluent Monitoring Plan 9. Operations, Maintenance & Performance Monitoring
Artificial Turf	Fort Huachuca	Utilize artificial turf where feasible to limit groundwater use for irrigation. Multiple PT Fields have been converted to artificial turf. Artificial turf reduces the need for irrigation and thus groundwater pumping.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-3	
Noxious Weeds Treatment	Fort Huachuca	The Fort treats about 30 acres annually for noxious weeds. Targeted weed spraying and removal helps to control the spread of noxious weeds. These weeds prevent the growth of native plants and create a heightened fire risk, leading to an increase in accelerated runoff and erosion.	ob-SOIL-2; g-WAT-1; g-VEG-ALL-4	
Mesquite Tree Extraction and Spraying	Fort Huachuca	The Fort treats about 178 acres annually for mesquite tree eradication. Targeted mesquite tree spraying and removal helps to control the spread of mesquite trees. Mesquite trees prevent the growth of native plants and create a heightened fire risk, leading to an increase in accelerated runoff and erosion.	ob-SOIL-2; g-WAT-1; g-VEG-ALL-4	
Wash Maintenance	Fort Huachuca	The Fort does maintenance of washes on an as needed basis. The purpose of the program is both to thin vegetation to healthy levels and maintain natural drainage characteristics. Regular wash maintenance reduces fuel in the wildland urban interface, which in turn changes fire behavior characteristics including reduced flame lengths, slower rates of spread, reduced fire intensity levels, and	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-5	

Management Actions

Action / Project Name	Project Lead	Description / Purpose	RMP Goals/Objectives Supported by Project	Planned Actions
		reduced crown fire potential. The reduced wildfire risk helps preclude accelerated runoff and erosion.		
Fort Huachuca Water Resource Plans	Fort Huachuca	The Army Water Resource Plan and Fort Huachuca Policy 21-70 implement the Fort's long-standing water conservation practices and policies to support water resource sustainment.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	
East Range Watershed Rehabilitation	Fort Huachuca	This Fort Huachuca Plan helps improve watershed condition on the Fort's East Range	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-5	
USGS Monitoring	Fort Huachuca	The Army and the USGS currently do monitoring of 3 stream gages, 5 stormwater detention basins and 14 groundwater monitoring wells.	ob-SOIL-2; g-WAT-1; ob-WAT-3, g-VEG-ALL-1	
Conservation Easement program	Fort Huachuca	The Fort uses programs such as the Readiness and Environment Protection Integration (REPI) Program and the Army Compatible Use Buffer (ACUB) program to place conservation easements on properties within the Upper San Pedro River Basin to protect habitat and protect water resources from present or future development. The Fort also utilizes many partners to achieve its goals in implementing this highly effective conservation easement program.		
Water Wise Energy Smart (WWES) program	Fort Huachuca	The Fort continues to fund and support the Water Wise Energy Smart (WWES) program. In total WWES conducted 1,260 contact hours with students in classroom instruction on conserving water and energy. A total of 2,080,670 square feet of military buildings were audited for energy/water during the past year (2020).		

A.6. Additional Future Management Actions

To maintain or exceed monitoring indicator targets and shared goals and interests of the MOU, additional management action may be analyzed, developed, and implemented in the future collaboratively or independently by the parties. To formally include any future management actions in this SPRNCA Cooperative Plan, the MOU parties will consult with the other parties and may add the activity to this SPRNCA Cooperative Plan through the adaptive management process described in the MOU.