MICHELLE LUJAN GRISHAM
GOVERNOR

JAMES C. KENNEY
CABINET SECRETARY

February 7, 2022

Via email: OW-Docket@epa.gov
Via Federal eRulemaking Portal: https://www.regulations.gov/

Re: Comments on Dec. 7, 2021, Notice of Proposed Rulemaking on Clean Water Act jurisdiction, Docket ID No. EPA-HQ-OW-2021-0602

Dear Assistant Administrator Fox and Assistant Secretary Pinkham,

The New Mexico Environment Department (NMED) is pleased to provide the following comments in support of the proposed rulemaking by the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE) (collectively, "the agencies") that restores the regulations in place prior to the 2015 Clean Water Rule defining "waters of the United States" (WOTUS), amended to be consistent with relevant Supreme Court decisions. 86 Fed. Reg. 69,372 (December 7, 2021).

NMED supports the agencies' decision to replace the Navigable Waters Protection Rule (NWPR) through two administrative rulemakings. We support the proposed rule's approach to interpret WOTUS consistent with the pre-2015 regulatory regime incorporating key standards established through U.S. Supreme Court decisions.

In the preamble to the proposed rule, the agencies request comment on several issues related to guidance on the "relatively permanent" standard and "significant nexus" standard. NMED supports clear federal guidance and rules for both standards that is consistent with the *Rapanos* guidance and:

- Applies both standards for all categories of waters, including other waters (e.g., playa lakes, wet meadows, etc.) and tributaries, and assessing jurisdiction over non-tributary open waters under the "relatively permanent" standard that is similar to the approach described in the *Rapanos* Guidance for assessing jurisdiction over adjacent wetlands.
- Clarifies that intermittent streams under the "relatively permanent" standard may flow less than three months each year (e.g., streams that flow continuously during certain times of the year).
- Establishes that the "relatively permanent" standard applies when the flows exist "during certain times of the year" without the need to clarify nor identify the sources of intermittent flow. Likewise, the agencies do not need to define flow classifications in the final rule as some states and tribes have these definitions in their own regulations and it may further complicate the issue.
- Under the "significant nexus" standard, evaluates the connectivity and effects of certain waters on downstream waters in a cumulative manner, to interpret "similarly situated," consistent with the best available science.
- Uses ecoregions and hydrologic landscape regions to evaluate the specific ecological functions performed by similarly situated waters and identify where similarly situated waters "in the region" could be considered cumulatively for a significant nexus analysis.

Finally, based on our review of the proposed rule and preamble, NMED urges USEPA and USACE to proceed with thoughtful action to achieve the following:

- Recognize that the burdens of environmental pollution fall disproportionately on minority, low-income, and indigenous populations and that climate change will exacerbate these exisiting environmental risks and associated health risks. Clearly, if the congressional objective of the Clean Water Act is to restore and maintain the Nation's waters, and given that climate change *has* exacerbated risks and will continue to exacerbate risks for the forseeable future, then maintaining the status quo will not maintain the integrity of the Nation's waters.
- Preserve and protect the rights of states and Tribes to prevent, reduce, and eliminate pollutants within their jurisdiction, including restoration, preservation, and enhancement of land and water resources through regulatory and other programs.
- Through the second rulemaking, advance the Clean Water Act's statutory objective to "restore the chemical, physical, and biological integrity of the Nation's waters" by considering the best available science, including climate benefits, hydrologic functions, and ecosystem services provided by intermittent and ephemeral tributaries, wetlands, and "other waters" that influence the water quality of "traditionally navigable waters."

NMED appreciates the extensive efforts your agencies are making to provide meaningful opportunities to hear critical input from states, tribes, and stakeholders. We support your commitment to initiate and implement a second rulemaking to provide clarity and to develop a durable rule grounded in sound science and informed by strong public engagement.

In addition to our letter, we are submitting the Department's September 30, 2021, WOTUS federalism consultation comments for inclusion in Docket ID No. EPA-HQ-OW-2021-0602, as well as the Department's *Hydrology Protocol* used to identify ephemeral, intermittent, and perennial waters in New Mexico, which may be useful for implementation and/or guidance purposes. The *Hydrology Protocol* is an appendix to New Mexico's USEPA-approved Water Quality Management Plan and Continuing Planning Process (WQMP-CPP).

Thank you for the opportunity to provide this feedback.

Sincerely,

Rebecca Roose Digitally signed by Rebecca Roose
Date: 2022.02.07 12:58:52 -07'00'

Rebecca Roose
Deputy Cabinet Secretary of Administration

Attachments:
NMED WOTUS federalism consultation comments to USEPA and USACE (September 30, 2021)
State of New Mexico WQMP-CPP Appendix C: Hydrology Protocol (October 23, 2020)

cc: Courtney Kerster, Senior Advisor, Office of Governor Michelle Lujan Grisham
John Rhoderick, Acting Water Protection Division Director, NMED
Shelly Lemon, Surface Water Quality Bureau Chief, NMED
John Verheul, Deputy General Counsel, NMED
Casey Katims, Deputy Associate Administrator for Intergovernmental Relations, USEPA

September 30, 2021

Radhika Fox
Assistant Administrator, Office of Water
U.S. Environmental Protection Agency
CWAwotus@epa.gov

Jaime Pinkham
Acting Assistant Secretary of the Army for Civil Works
Department of the Army
usarmy.pentagon.hqda-asa-cw.mbx.asa-cw-reporting@mail.mil

Re: Federalism Consultation Comment Period for Revising the Definition of "Waters of the United States"

Dear Assistant Administrator Fox and Acting Assistant Secretary Pinkham,

On behalf of the New Mexico Environment Department (NMED), enclosed please find our pre-proposal comments on efforts by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) to develop a revised definition of "waters of the United States" (WOTUS).

NMED appreciates the efforts your agencies are making to act with the urgency this topic demands, while also providing meaningful opportunities to hear critical input from states, tribes and stakeholders. We support your commitment to develop a durable rule grounded in sound science and informed by strong public engagement.

Thank you for the opportunity to provide this early input through the federalism consultation process.

Sincerely,

Rebecca Roose (for J. Kenney)
Digitally signed by Rebecca Roose (for J. Kenney)
Date: 2021.09.30 10:56:50 -06'00'

James C. Kenney
Cabinet Secretary

Attachment

cc: Casey Katims, Deputy Assistant Administrator, Intergovernmental Relations
John Goodin, Director of the Office of Wetlands, Oceans and Watersheds, EPA
Courtney Kerster, Director of Federal Affairs, Office of Governor Michelle Lujan Grisham
Rebecca Roose, Deputy Secretary of Administration, NMED
John Rhoderick, Acting Water Protection Division Director, NMED
Shelly Lemon, Surface Water Quality Bureau Chief, NMED
Don Welsh, Executive Director, Environmental Council of States
Julia Anastasio, Executive Director and General Counsel, Association of Clean Water Administrators

Attachment:
NMED Comments during Federalism Consultation for
Revising the Definition of Waters of the United States (WOTUS)
September 30, 2021

Comment 1: Maintain urgency to develop a durable rule.
In light of the recent decision from the U.S. District Court for the District of Arizona, NMED applauds EPA and USACE (agencies) for quickly announcing a return to the pre-2015 definition of Clean Water Act (CWA) jurisdiction for ongoing implementation nationwide. New Mexico urges the agencies to proceed with the rulemaking with the same sense of urgency demonstrated by the federal government since January 2021.

The Navigable Waters Protection Rule (NWPR) that went into effect in New Mexico on June 22, 2020, left approximately 93% of the state's surface waters without federal protection. The NWPR also created uncertainty for the regulated community in New Mexico. The details of these harms are perhaps best articulated in the written and verbal testimony of Rebecca Roose, Deputy Secretary of the New Mexico Environment Department, before the Senate Committee on Environment and Public Works (September 16, 2020), available at https://www.epw.senate.gov/public/index.cfm/2020/9/stakeholder-reactions-the-navigable-waters-protection-rule-under-the-clean-water-act. For the reasons summarized above and detailed in that testimony, New Mexico urges the agencies to proceed expeditiously to promulgate a durable rule that will increase protections for surface waters, meet the growing challenges of climate change, and provide regulatory certainty beyond the current administration's term.

Comment 2: EPA and USACE must genuinely consult states and tribes.
The agencies are off to a great start by providing federalism consultation early in the process and extending the comment period in response to multiple intergovernmental association requests. The CWA embodies federalism principles, demonstrating Congress' intent to protect the primary rights and responsibilities of states over water quality and the allocation and protection of land and water resources. CWA section 101(g) states "Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources." As EPA and USACE have heard many, many times from states and tribes, co-regulators expect a seat at the table alongside federal subject matter experts, independent scientists and economists, local community members, affected business owners and environmental advocates.

Federal rulemaking outcomes are more beneficial and likely to withstand the test of time when the rule writers take time to listen to the unique experiences and expertise at the state, tribal and local level. Besides the obvious beneficial uses such as aquatic life and recreation, New Mexico's surface waters also play an important cultural role in the State. Many tribes, nations and pueblos in New Mexico use and protect their surface waters for cultural uses. Cultural uses may relate to a wide range of connections, including spiritual relationships, language, songs, stories, sacred places, the plants and animals associated with water, drinking water, and recreational or ceremonial purposes. Additionally, in northern New Mexico, acequias – or community-operated irrigation ditches – have been operating for centuries. Acequia water use and acequia-related cultural values are at risk due to increasing urbanization pressures and impacts from land use change on actual water use, water quality, and riparian vegetation.[1] At least one state's highest court has recognized the importance of cultural practices involving water.[2]

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[1] *See* https://lasacequias.org/.
[2] *See* In re Gen. Adjudication of All Rights to Use Water in Gila River Sys. & Source, 201 Ariz. 307, 318–19, 35 P.3d 68, 79–80 (2001).

To truly take into account the unique expertise, values and experiences of states and tribes, the agencies must continue to consult with co-regulators at each step of the process leading to a durable rule that redefines CWA jurisdiction. NMED urges the agencies to use the feedback provided here as a starting point for dialogue with New Mexico as the proposed rule takes shape.

Comment 3: Implementation of pre-2015 WOTUS definition should be consistent with the Kennedy concurring opinion.

New Mexico urges the agencies in restoring the regulations in place prior to the 2015 Clean Water Rule to incorporate the Kennedy concurring opinion to *Rapanos v. United States*, 547 U.S. 715 (2006), which articulates what has come to be known as the "significant nexus" test. The Kennedy concurring opinion is the opinion most often cited in significant WOTUS cases since *Rapanos*. Essentially the Kennedy concurring opinion was the law as far as courts were concerned from 2006 until 2015. Prior to promulgating a final rule with a new, durable WOTUS definition, the agencies must restore the definition in place prior to the 2015 Clean Water Rule, consistent with the Kennedy concurring opinion.

Comment 4: Upcoming proposed rule must be based on the best available science.

To meet EPA's clear intention of developing a durable rule, it is absolutely essential that any new proposal must be grounded in science. The Agencies should address and revise (as appropriate) the scientific conclusions reached in the 2015 reports *Economic Analysis of the EPA-Army Clean Water Rule* and *Technical Support Document for the Clean Water Rule: Definition of Waters of the United States.* In addition, the agencies should carefully consider allegations that the NWPR, and/or the process to develop it, violated principles of scientific integrity. Comments 5 through 9 below provide more specific comments regarding the essential scientific underpinnings of the agencies' future rule.

Comment 5: Upcoming proposed rule must reflect the significance of ephemeral waters in the hydrologic cycle and their relevance to the objectives of the CWA.

In New Mexico, and the Southwest in general, ephemeral and intermittent streams are fundamental to maintaining water quality and overall watershed function in lakes, wetlands and perennial rivers. In the arid Southwest, ephemeral streams are estimated to constitute up to 90 percent of all surface waters and are ecologically and hydrologically significant in arid and semi-arid watersheds. Ephemeral waters feed into traditionally navigable waters (TNWs) and other jurisdictional waters, carrying water, nutrients and sediment throughout watersheds and providing important ecological and hydrologic connections, when functioning properly. [3] Furthermore, individual ephemeral or intermittent streams cannot be scientifically isolated because the cumulative effects of these streams impact the hydrological, biogeochemical and ecological functioning of a watershed. Simply stated, the NWPR's categorical exclusion of ephemeral streams is clearly at odds with hydrologic science.

Without adequate CWA protections for ephemeral waters, TNWs will be negatively impacted by uncontrolled sediment, nutrients, industrial and other pollutants from upstream ephemeral sources. A revised, durable WOTUS definition must recognize and maintain the jurisdictional status of ephemeral waters that have a nexus to a downstream TNW. In New Mexico and other arid states, all waters are precious resources that must be protected, regardless of when or how long they flow.

Comment 6: Upcoming proposed rule must account for impacts of climate change on the hydrologic cycle.

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[3] Levick, L., J. Fonesca, D. Goodrich, M. Hernandez, D. Semmens, J. Stromberg, R. Leidy, M. Scianni, D.P. Guertin, M. Tluczek, and W. Kepner. 2008. The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest. U.S. Environmental Protection Agency and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, 116 pp.

Adding to the requisite sense of urgency for the agencies' rulemaking initiative, available science indicates the NWPR is less protective of the hydrologic cycle and therefore less protective of public health and the environment as we face more frequent and intense droughts due to climate change. Even though the NWPR is no longer regarded by the agencies as the applicable WOTUS definition, states have lost critical time in pollution prevention efforts and many approved projects of the past 18 months are already causing irreversible harm to fragile watersheds.

In the southwestern United States, clean water, wildlife habitat, and local economies are being adversely impacted due to drought and wildfire caused by climate change.[4,5,6]
With a warming climate, more and more of New Mexico's waters are drying up. As waters become stressed by drought, overuse, and groundwater mining, many perennial and intermittent streams and springs will fade. Currently, many major "rivers" and "tributaries" in the State are not entirely perennial (e.g., the Rio Grande, Canadian River, Rio Puerco, Rio Galisteo, Dry Cimarron, Ute Creek, Rio Hondo, etc.).

Today across New Mexico, climate change is stressing already depleted or mined groundwater systems resulting in decreased groundwater recharge. More severe or sustained droughts are and will stress water resources and force increasing competition for water resources among the agricultural, energy, metropolitan, and ecological sectors. Climate change is contributing to water scarcity in the Southwest, but it is also impacting *water quality* in the region. As temperature and precipitation patterns affect the abundance, type, and distribution of water, vegetation cover, and wildfire in watersheds — all of which alter water chemistry — changes in flood magnitude and duration, sediment and other pollutant loads, physical habitat and biological communities will likely occur.

NMED requests the agencies review and include in the record a new draft report from an esteemed team of New Mexico climate and water resource scientists, *Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources*, which includes a focus on water quality impacts.[7]

Comment 7: Upcoming proposed rule must account for the cumulative, scientifically demonstrated impacts on downstream TNWs.
One of the many important findings of EPA's 2015 report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* is that "the scientific literature unequivocally demonstrates that streams, regardless of their size or frequency of flow, are connected to downstream waters and strongly influence their function." In New Mexico, ephemeral tributaries contribute up to 76% of the stormflow in the Rio Grande after a storm event. Where pollutants can be mobilized, ephemeral stormflows will deliver the pollutants to downstream waters. The cumulative impact of these ephemeral stormflows is undoubtedly detrimental to downstream water quality.
One of many examples in New Mexico where cumulative effects are tangible is on the Pajarito Plateau, near the town of Los Alamos. Many ephemeral streams that run through and adjacent to the Los Alamos

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[4] *See* https://www.demos.org/sites/default/files/publications/UpdatedNMFullReport.pdf.
[5] *See* https://aces.nmsu.edu/pubs/research/economics/TR45/welcome.html.
[6] Climate Change-related online resources:
- NOAA Fourth National Climate Assessment: Chapter 25, Southwest, available at https://nca2018.globalchange.gov/chapter/25/.
- Assessment of Climate Change in the Southwest United States (2013), available at https://climas.arizona.edu/sites/default/files/pdf2013sw-nca-color-finalweb.pdf.
- National Park Service Series: Climate Change in the Southwest, available at https://www.nps.gov/articles/climate-change-in-the-southwest-potential-impacts.htm.
- EPA: Climate Impacts in the Southwest, available at https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-southwest_.html.

[7] Allen, C., D. DuBois, P. King, L. McFadden, B. Thomson, and A. Tillery. 2021. New Mexico Bureau of Geology and Mineral Resources. Draft for Public Comment, available at https://geoinfo.nmt.edu/ClimatePanel/report/.

National Laboratory (LANL) on the Pajarito Plateau are contaminated with pre-CWA ("legacy") pollutants from federal government activities dating back to the Manhattan Project. These ephemeral streams flow directly to the Rio Grande adjacent to the Buckman Direct Diversion, the surface water intake for the City of Santa Fe and Santa Fe County's drinking water supply. The cumulative impact from these drainages on the Rio Grande and downstream water supplies could be significant and threaten human health and the environment. Any eventual proposed rule must take a watershed approach to protecting water quality to account for cumulative impacts, including cumulative impacts from ephemerals, on downstream waters.

Comment 8: Upcoming proposed rule must consider its effects on wetlands.
Saint Mary's University of Minnesota's Geospatial Services, with input from the New Mexico Environment Department (NMED), created a model to evaluate the extent of federally protected wetlands and other surface waters.[8]

The model uses three different analysis scenarios from "most restrictive" to "very restrictive" to "less restrictive." The most restrictive scenario limits CWA protections to directly adjacent and perennial (i.e., permanent) surface waters. The very restrictive scenario limits protections to adjacent and perennial/intermittent waters. The less restrictive scenario offers protections to adjacent wetlands, perennial, intermittent and ephemeral waters, and ditches or channelized streams. The model analyzed three different watersheds in the United States, one of which was the Cimarron River watershed in New Mexico. The Cimarron River Watershed drains approximately 1,049 square miles in northwestern New Mexico and flows into the Canadian River, a jurisdictional waterbody. Annual precipitation ranges from 30 inches in the higher elevation alpine forests to 15 inches in the semiarid grasslands at lower elevations.

The results of this case study show that by narrowing the scope of federal jurisdiction under the "most" and "very" restrictive scenarios, the number of wetlands protected by the CWA are *substantially* decreased, leading to a potential loss of benefits provided by wetlands such as flood control and attenuation, pollution control, wildlife habitat, and recreation. The Cimarron Watershed model looked at 5,200 wetlands covering 20,000 acres. Model results indicate that the very restrictive scenario would remove protections from 3,600 acres and the most restrictive scenario would remove protections from 14,000 acres, approximately 70 percent of total wetland acreage. Beyond this modeling exercise, the Ute Park Fire severely burned approximately 58 square miles in the Cimarron Watershed and through the Cimarron River valley in June 2018. The wildfire burned through this special trout water and clogged drinking water intakes for several downstream communities. In addition, post-fire flooding and debris flows wreaked havoc in several rural communities and individual households. It can be concluded that the most restrictive scenario will have deleterious effects to watershed protection and restoration efforts in this watershed, and similar watersheds.

Adjacent wetlands have a strong influence on the chemical, physical, and biological integrity of nearby waters. "Adjacent" should be defined as "bordering, continuous, or neighboring" (this could be further defined by distance or connection). Wetlands that are separated by dikes, barriers, or similar structures should be considered adjacent and jurisdictional. In western states such as New Mexico, these "separated" wetlands are certainly not isolated and profoundly influence nearby waters and downstream tributaries and TNWs.

Comment 9: Accurate and complete data are integral to any proposal to revise the scope of the CWA.
Without accurate data, the impacts of any eventual proposed rule would be unknown and likely underestimated, especially in an arid state like New Mexico. The Agencies must ensure accurate and complete data are available before proposing any new rule.

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[8] *See* https://www.arcgis.com/apps/Cascade/index.html?appid=f3de6b30c0454c15ac9d3d881f18ae33.

Sufficient data were not available to implement the NWPR, and available U.S. Geological Survey National Hydrography Dataset (NHD) geospatial datasets are inaccurate and therefore misleading. For New Mexico, there is no accurate dataset that distinguishes between ephemeral and intermittent waters, and most waters shown as intermittent in the NHD are actually determined to be ephemeral when a site evaluation is conducted. Therefore, any discussion of the impact of any eventual proposed rule based on the NHD drastically underestimates the number of miles of ephemeral waters in New Mexico that lost jurisdiction under the NWPR.

An example of a watershed where this condition exists is the Rio Puerco watershed, the largest tributary to the Rio Grande in central New Mexico. In the NHD, the Rio Puerco is characterized as perennial in its upper portion and intermittent in its lower portion; however, the flow regime based on gage data for the Rio Puerco downstream of the perennial segment alternates between ephemeral and intermittent conditions.

The Rio Puerco basin drains portions of seven counties, encompassing approximately 7,350 square miles (4.7 million acres). While the Rio Puerco watershed contributes less than 10 percent of the total water flow to the Rio Grande, it is a primary source of sediment, contributing up to 80 percent of the sediment load including potential contaminants carried with the sediment.

Comment 10: Upcoming proposed rule must include interstate waters in the definition of WOTUS.
Federal jurisdiction of interstate waters is critical because of the agencies' function as federal partners who can help mitigate and manage water quality impacts from upstream states. The agencies' role as co-regulators is critical to water quality issues that cross state and tribal boundaries and provides consistency to help resolve conflicts or water quality issues that may arise between states and/or tribes.

An example of an interstate water in New Mexico that could be impacted by this change is the Gila River. The Gila River is a desert river, flowing 649 miles from southwestern New Mexico to Yuma, Arizona where it joins the Colorado River. The Gila River originates in the Nation's first designated wilderness area, the Gila Wilderness, and is rich in biological diversity and cultural history.

Although the Gila is one of the longest rivers in the West, it typically goes dry before it gets to the Colorado River due to large irrigation diversions, groundwater mining, and sustained drought. Some segments of the Gila River in Arizona have been designated as TNWs, however continuous surface connection is difficult to demonstrate along many segments of the river. Any eventual proposed rule should include interstate waters as a separate jurisdictional category of WOTUS to provide consistency and help resolve conflicts and water quality issues that may arise between states and/or tribes.

Comment 11: Clarifying CWA funding and ensuring long-term federal support for state and tribal programs.
States and tribes are a critical part of achieving our nation's environmental and public health goals in an effective and efficient way. EPA should provide assurance that funding will go directly to states and tribes with a demonstrated financial need in order to successfully implement water quality management and pollution control programs. Financial support for pollution control programs has been steadily weakened and funding has been repeatedly reduced to the detriment of these programs and consequently to the detriment of our nation's waters. This issue must be addressed in the financial impact report for any eventual proposed rule.

As described in the CWA, appropriated funds are allotted among the state and interstate water pollution control agencies on the basis of the extent of the pollution problems in the respective states. The six components in the Section 106 State allotment formula selected to reflect the extent of the water pollution control problems in the United States are: (1) surface water area; (2) ground water use; (3) water quality impairment; (4) point sources; (5) non-point sources; and (6) population of urbanized areas. This raises the question of whether states with a larger number of jurisdictional waters will receive a greater percentage of EPA grant funds as a result of any eventual proposed rule. Through Section 106, the State of New Mexico currently receives federal grants for water pollution control programs, such as water quality monitoring, assessment, watershed management (TMDLs), water quality standards, inspections, point source control, database management, quality assurance, and reporting. New Mexico currently receives funding under CWA Sections 104(b)(3), 106, 319, and 604(b) for various pollution control and water quality management programs. Any further reductions to grant funding will significantly reduce the effectiveness and success of these CWA programs in New Mexico.

New Mexico urges EPA to take the time necessary to fully understand the potential financial and programmatic consequences to state and tribal CWA programs before proposing any new rule. Many states and tribes cannot implement a robust and successful water quality program without significant federal assistance. The funding impacts for EPA grants to states and tribes should be clearly explained in the Preamble to any eventual proposed rule, thereby remedying a shortcoming of the NWPR. The agencies could consider opportunities for the revised WOTUS rule to be a strong foundation for long-term ample federal investments in state and tribal programs.

Comment 12: The economic analysis of the upcoming proposed rule must estimate the costs and benefits to states, tribes, municipalities and industry.

Economic benefits of clean water and healthy watersheds are extensive. While evaluating the costs to industry associated with compliance across all CWA-regulated activities affecting jurisdictional waters, the agencies must also analyze the full range of economic benefits.

Ranching and farming are huge industries that depend on high quality rivers, lakes and wetlands. Municipalities face near and long-term infrastructure upgrade and maintenance costs to roads, bridges and water infrastructure when surface waters are not fully protected. In addition, the outdoor recreation economy in western states is becoming a larger economic driver at the state and local levels, which depends on thriving aquatic ecosystems. The Outdoor Industry Association, a trade organization, says that in New Mexico the sector supports 99,000 jobs, creates nearly $10 billion in consumer spending every year and contributes $623 million in state and local tax revenue. The state Department of Game and Fish reports there are 160,000 anglers who fish in New Mexico, spending $268 million, and 87,600 hunters, who spend $345 million, on their activities annually.

State of New Mexico
Water Quality Management Plan
& Continuing Planning Process

Appendix C

Hydrology Protocol

for the

Determination of Uses Supported by
Ephemeral, Intermittent, and Perennial Waters

Originally Approved May 2011
Approved Revision October 23, 2020

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EXECUTIVE SUMMARY

The *Hydrology Protocol* provides a methodology for distinguishing among ephemeral, intermittent and perennial streams and rivers in New Mexico. The results of the *Hydrology Protocol* may also aid in the designation of appropriate designated uses supported by those waterbodies as a result of flow regime. New Mexico's water quality standards (*Standards for Interstate and Intrastate Surface Waters*, 20.6.4 NMAC) set distinct protections for unclassified ephemeral, intermittent and perennial waters (*see* 20.6.4.97 to 99 NMAC) and also identify many classified waters by their hydrology, e.g. "perennial tributaries to" or "perennial reaches of" (*see* 20.6.4.101 to 899 NMAC). Hydrological determinations are key to assuring that the appropriate designated uses and water quality criteria are applied to a particular waterbody.

The *Hydrology Protocol* was specifically developed to generate documentation of the aquatic life and recreation uses supported by the hydrology of a given stream or river. This information can then be used to provide technical support for a Use Attainability Analysis (UAA). Under particular circumstances, the use of the *Hydrology Protocol* can be used for the expedited UAA process (20.6.4.15(C) NMAC), which facilitates the efficient application of the limited aquatic life and secondary contact uses to ephemeral waters, where appropriate, prior to undergoing the full administrative rule-making process. However, the *Hydrology Protocol* cannot be used in place of the UAA.

SWQB or any other party may conduct a *Hydrology Protocol* survey as part of a UAA in accordance with UAA requirements found under 40 CFR 131.10, 20.6.4.15 NMAC and the State's approved Water Quality Management Plan/Continuing Planning Process (WQMP/CPP), therefore the user/evaluator may be a member of SWQB, another regulatory agency, a contractor, or a member of the public.

The information gained from the protocol can also be used to identify unclassified waters within an otherwise classified standards segment. The details of these specific applications are described in Section II of *New Mexico's Water Quality Management Plan and Continuing Planning Process*, to which this *Hydrology Protocol* is an appendix. Other applications where a determination of stream hydrology is necessary are possible but results of the *Hydrology Protocol* must be evaluated cautiously within the specific decision framework of the study.

The protocol relies on hydrological, geomorphic and biological indicators related to the persistence of water and is organized into two levels of evaluations: Level 1 and Level 2. Data gathered during the Level 1 Evaluation should, in most cases, provide enough information to give a clear indication of the hydrological status of the stream. The "*Hydrology Determination Field Sheets,*" a.k.a. "*Field Sheets,*" was developed to record the information collected through application of the *Hydrology Protocol* and may be used to support the UAA process. The Level 1 Evaluation Field Sheets provide some of the necessary information needed in a Use Attainability Analysis to demonstrate a stream is ephemeral, intermittent or perennial. Attainment of a specific Clean Water Act Section 101(a)(2) aquatic life and recreational use may not be feasible due to the factor identified in 40 CFR 131.10(g)(2): *natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use*. The data obtained through a Hydrology Protocol survey provides some of the information that would be necessary to demonstrate that attainment is not achievable but, is only one of the elements required under a UAA to demonstrate the evidence to support changing a designated use.

In certain instances, additional data and supporting information are necessary to determine the hydrological condition of the stream. The methods described as part of the Level 2 Evaluation may be conducted if the Level 1 Evaluation is inconclusive (i.e. the score falls within a gray zone, see Section 2, Table 5). The Level 2 Evaluation relies on more intense and focused data collection efforts and provides the evaluator with additional data and observations to make a final hydrological determination. The Level 2 Evaluation may be used for either an expedited or regular UAA as documentation to support the proper standards classification of a given stream.

Regardless of whether a Level 1 or Level 2 Evaluation is performed, the SWQB encourages the evaluator to gather as much information as possible to make an accurate assessment of the stream. Recommendations are provided in the protocol, but other data not included in these recommendations may be gathered as well.

Table of Contents

I. INTRODUCTION

Streams are drainage features that may exhibit ephemeral, intermittent or perennial characteristics or change from ephemeral to intermittent and intermittent to perennial along a gradient or continuum—sometimes with no single distinct point demarcating these transitions. Nevertheless, all stream systems are characterized by interactions among hydrological, biological, and geomorphic (physical) processes. According to Maidment (1993), *Streamflow* can be described as flowing surface water along a defined natural channel generated by a combination of:

- *Stormflow* – streamflow resulting from the relatively rapid runoff of precipitation from the land as interflow (rapid, unsaturated, subsurface flow), overland flow, or saturated flow from raised, near surface water tables close to the stream.
- *Baseflow* – return flow from sustained groundwater discharge into the channel.
- Contributions of discharge from upstream tributaries as stormflow or baseflow.
- Contributions of discharge from point source dischargers and irrigation return flows.

The *Hydrology Protocol* uses attributes of hydrological, biological and geomorphic processes to produce a quantitative score. The score is then used to characterize the stream as "ephemeral," "intermittent," or "perennial". The term "stream", as it pertains to the *Hydrology Protocol*, refers to a wadable, lotic water body (typically 1^{st}, 2^{nd}, or 3^{rd} Strahler stream order) and the term "river" refers to a non-wadable, lotic water body (generally 4^{th} Strahler stream order or higher). Throughout this document the terms are interchangeable with one another as the same process and procedures are used regardless of whether the channel is wadable or not.

II. DEFINITIONS

The *Hydrology Protocol* is based on the definitions of "ephemeral," "intermittent" and "perennial" adopted by the WQCC in 20.6.4.7 NMAC as follows:

> ***"Ephemeral"*** *when used to describe a surface water of the state means the water body contains water briefly only in direct response to precipitation; its bed is always above the water table of the adjacent region.*
>
> ***"Intermittent"*** *when used to describe a surface water of the state means the water body contains water for extended periods only at certain times of the year, such as when it receives seasonal flow from springs or melting snow.*
>
> ***"Perennial"*** *when used to describe a surface water of the state means the water body typically contains water throughout the year and rarely experiences dry periods.*

III. HYDROLOGY DETERMINATION AND RATING FORM

A. General Information

There are two levels of evaluation for the *Hydrology Protocol* (HP). Data gathered during the Level 1 Evaluation should, in most cases, provide enough information to give a clear indication of the hydrological status of the stream. However, a more in-depth Level 2 Evaluation may be used to gather more information and data for more complex borderline cases. The *Field Sheets* are used to record the information and data collected through application of the HP.

For waterbodies where an HP is being conducted with the intent to remove a designated use that is not an existing use, as defined under 40 CFR 131.3 and 20.6.4.7(E)(3) NMAC, a UAA must be prepared. Third-party UAAs conducted in accordance with 20.6.4.15(D) NMAC, must have a workplan, approved by the Department, prior to conducting an HP UAA.

Although the HP is used as supporting evidence in a UAA, it is beyond the scope of this document to provide guidance on preparing a UAA.

B. User/Evaluator Experience

In order to distinguish ephemeral streams and rivers from non-ephemeral ones or intermittent streams and rivers from perennial ones using the information presented in this protocol, the evaluator should have experience making geomorphic, hydrological, and biological observations in New Mexico or in the semi-arid climate of the southwestern U.S.

The *Hydrology Protocol* was designed to provide the necessary supporting documentation for a UAA based on natural hydrologic flow conditions. In accordance with 20.6.4.15 NMAC, NMED or any other party may conduct a UAA, therefore the User/Evaluator for the *Hydrology Protocol* may be a member of NMED, another regulatory agency, a contractor, and/or a member of the public. It should be noted that only the Department can submit an expedited UAA using the *Hydrology Protocol* for EPA's technical review and approval, as described under 20.6.4.15(C) NMAC.

C. Drought Conditions

Spatial and temporal variations in stream attributes occur in stream systems. These variations can affect persistence and volume of streamflow. The changes to the system's flow regime can be related to seasonal precipitation and evapotranspiration patterns, as well as influenced by recent weather and interannual climate variability.

Local drought and weather data should be reviewed prior to evaluating flow conditions in the field. Perennial streams will have water in their channels year-round in the absence of drought conditions. Therefore, it is *strongly* recommended that field evaluations be conducted outside of drought conditions whenever possible.

Drought conditions, for the purposes of this *Hydrology Protocol*, are defined as any time the Standardized Precipitation Index (SPI) is less than -1.5, indicating severely to extremely dry conditions as described by the National Drought Mitigation Center (NDMC 1995). The 12-month SPI will be used to determine drought conditions and noted on the *Field Sheets*. The 12-month SPI should be verified through other sources such as the Standardized Precipitation Evapotranspiration Index (Beguería, et al. 2014) or the United States Drought Monitor to ensure that extreme or exceptional drought conditions are not indicated for the survey location.

The 12-month SPI was chosen for use in the *Hydrology Protocol* because SPIs of this time-scale can be linked to groundwater-surface water fluctuations and reservoir storage, it can provide an early warning of drought, and it can help assess drought severity. The SPI calculation for any location in New Mexico is based on 10 climate regions of New Mexico and long-term precipitation records (both rainfall and snowpack), and has available archived maps dating back to 1996. The 12-month SPI value for a particular stream is included as another piece of evidence to be evaluated before making a final stream determination. If the evaluator believes that extreme conditions such as severe drought or abnormal precipitation are influencing the overall rating, he may want to postpone a final decision until another evaluation can take place during more normal conditions.

D. Recent Rainfall Activity

Recent (generally considered to be within 48 hours) rainfall or snowmelt can also influence scoring; therefore, it is *strongly* recommended that field evaluations be conducted at least 48 hours after the last known major rainfall or snowmelt. Field observations regarding the presence or absence of recent high flows should be made and documented on the *Field Sheets* to supplement any available local rain gauge data and to determine if field observations were made at least 48 hours following a precipitation or runoff event. To reduce this source of variability, the Level 1 Field Evaluation should occur during stable baseflow conditions which will vary by region and elevation of the sample reach but are typically between late May and mid-July (to avoid snowmelt) or mid-September and early November (to avoid monsoons). The protocol and scoring mechanism were designed with redundancy (i.e. multiple indicators) to allow for defensible scoring even within 48 hours after a recent rainfall or during drought conditions. Nevertheless, performing field evaluations during or after severe conditions, such as floods or drought, is not optimal nor is it recommended.

E. Scoring

The *Field Sheets* are used to record the score for each attribute and determine the total numeric score for the sample reach under investigation. The *Field Sheets* specifically request information regarding: date, project, evaluator, site, Assessment Unit (AU), 12-month SPI value, latitude/longitude, as well as any other pertinent observations (such as indications of recent rain events). Additional notes for the Field Sheets should include the most recent precipitation date and amount from the closest rain gage, if available, and evidence of any anthropogenic influences and modifications. The *Field Sheets* are an official record, so all pertinent observations should be recorded on it.

In order to assess the natural variability encountered when making hydrological determinations in the field, a four-tiered, weighted scale was developed for evaluating and scoring each hydrological attribute. The scores that are applied to sets of geomorphic, hydrological and biological attributes are: poor, weak, moderate, and strong. *Moderate* scores are intended as an approximate qualitative midpoint between the two extremes of *Poor* and *Strong*. The score ranges were developed to better assess the often gradual and variable transitions of streams from ephemeral to non-ephemeral. The remaining qualitative description of *Weak* represents gradations that will often be observed in the field. Definitions of poor, weak, moderate and strong are provided in **Table 1**. These definitions are intended as guidelines and the evaluator must select the most appropriate category based upon experience and observations of the sample reach under review, its watershed, and physiographic region.

The quantitative score given to each attribute reflects the evaluator's qualitative assessment of the characteristic along the sample reach. These category range within each of the characteristics allows the evaluator flexibility in assessing variable features or attributes. In addition, the incremental category gradients reduce the variability of range in scores between different evaluators. There may be circumstances where intermediary scores between the categories presented for each indicator are appropriate. In those cases, document the rationale for the intermediary score on the *Field Sheets*.

Table 1. Guide to Scoring Categories

Category	Description
Strong	The characteristic* is easily observable (i.e. observed within less than one minute of searching).
Moderate	The characteristic is present and observable with minimal (i.e. one or two minutes) searching.
Weak	The characteristic is present, but you have to search intensely (i.e., ten or more minutes) to find it.
Poor	The characteristic is not observed.

*****geomorphic, hydrological or biological

F. Level 1 Evaluation: Data Collection for the Hydrology Determination of NM Streams and Rivers

1. Level 1 Office Procedures

The following information should be gathered and reviewed prior to conducting field work for a Level 1 Field Evaluation. It is important to gather as much physical and geographic information as possible by conducting reconnaissance on the stream reach prior to going out to the study site to save time, money and other resources and identify any risks or concerns.

Geographical Information System (GIS) and Remote Sensing Tools
The following is a non-exhaustive list of suggested coverages and resources that can help identify and generate informative maps of the field of study area. In addition, the aerial photographs, GIS coverages and resources listed below can be used to calculate sinuosity prior to field work (see *Indicator* #1.7 (Sinuosity) for more information).

Useful resources include:

- Google Earth
- SWQB Mapper (https://gis.web.env.nm.gov/oem/?map=swqb)
- GIS software (ArcMAP, QGIS, etc.)

Useful coverages that can be added to a GIS project include (Note, not all information listed here will be available for every stream.):

- SWQB water quality stations
- SWQB assessment units
- National Hydrography Dataset (NHD) streams
- Southwest Regional Gap Analysis (http://swregap.nmsu.edu/default.htm)
- Office of the State Engineer (OSE) data
- The United States Geological Survey (USGS) quadrangle maps
- Aerial photographs
- National Hydrography Dataset
- Digital Geologic Map of NM
- National Land Cover Dataset
- Bureau of Land Management (BLM) Land Status
- United States Department of Agriculture (USDA) or Natural Resources Conservation Service (NRCS) soil survey
- Omernik Ecoregions
- NM Roads

Streamflow

Historic or recent flow data from gages such as those managed by the USGS, OSE or Los Alamos National Laboratory (LANL) should be used to make hydrological determinations. Streamgage data, if available, may clearly indicate ephemeral, intermittent, or perennial flow patterns for the available period of record and will facilitate the scoring of Indicator #1.1 *Water in Channel*.

Useful resources include:

- USGS Current Water Data for New Mexico: https://waterdata.usgs.gov/nm/nwis/rt
- OSE Real-Time Water Measurement Information System: http://meas.ose.state.nm.us/
- Los Alamos Area Environmental Data (Intellus): https://www.intellusnm.com

Drought Conditions

The following resources will help determine drought conditions and recent rainfall activity. At a minimum, the 12-month Standardized Precipitation Index (SPI) should be recorded on the *field sheets* along with the date and source the SPI was evaluated. Note, not all information listed here will be available for every stream:

- Historic or recent flow data (known sources include SWQB, OSE, USGS, or localized sources such as Los Alamos National Laboratory for waters on the Pajarito Plateau)
- Standardized Precipitation Index (SPI)
  - https://hprcc.unl.edu/maps.php?map=ACISClimateMaps
- Standardized Precipitation Evapotranspiration Index (SPEI)
  - http://spei.csic.es/index.html
- Rain gauge stations within the County
- Airport/regional climate data
- The National Weather Service:
  - https://w2.weather.gov/climate/index.php?wfo=abq
- https://w2.weather.gov/climate/xmacis.php?wfo=abqhttps://water.weather.gov/ahps/United States Drought Monitor https://droughtmonitor.unl.edu/
- PRISM Climate Data:
  - http://www.prism.oregonstate.edu/mtd

Refer to *Drought Conditions* and *Recent Rainfall Activity* on pages 6-7 for more information.

Stream Segment Identification and Sample Reach Selection

This protocol describes a method for assessing geomorphic, hydrological, and biological indicators of stream flow duration. However, flow characteristics often vary along the length of a stream, resulting in gradual transitions in flow duration. Choosing the sample reach on which to conduct an assessment can influence the resulting conclusion about flow duration. Before a determination of hydrology can be made for a stream the appropriate sample reach, within the larger stream segment to which the UAA will apply, must be identified.

For SWQB stream segments are termed **assessment units** (**AUs**). AUs are river or stream reaches defined by various factors such as hydrologic or watershed boundaries, geology, topography, incoming tributaries, surrounding land use/land management, water quality standards, etc. AUs are designed to represent waters with assumed homogeneous water quality (WERF 2007). AUs in New Mexico average 10 miles in length and are typically no more than 25 miles in length. A **sample reach**, as used in this protocol, is a length of stream (40 times the average stream bankfull width or 160 meters, whichever is larger) that is chosen to represent a uniform set of physical, chemical, and biological conditions within an AU. It is the principal sampling unit for collecting hydrological, geomorphic and biological data using this protocol. Below are several factors to look for when determining the homogeneity of the AU and the representativeness of the sample reach:

- Are there significant tributaries (2nd order or higher) entering along the reach?
- Are there any changes in geology?
- Are there any dramatic shifts in land use?
- Is there a dramatic change in slope?
- Are there changes in riparian vegetation type and amount?
- Are there any point sources discharging into the reach?
- Are there any irrigation return flows discharging into the reach?

Many of these questions may be evaluated using maps and remote sensing products (e.g. Google Earth), however field reconnaissance along the length of the AU – to evaluate potential gradients in stream hydrology and to select representative sample reach(es) for hydrologic evaluation – should also be conducted.

The sample reach(es) selected for evaluation with the Hydrology Protocol should be as representative as possible of the natural characteristics of the AU. For example, if the stream is mostly vegetated, the sample reach should be located along an area of the channel that is mostly vegetated as opposed to an area that has no vegetation or is sparsely vegetated. It is the responsibility of the assessor(s) to verify and document the homogeneity of the AU and representativeness of the sample reach. SWQB typically defines a representative sample reach for conducting data collection as 40 times the average stream width or 160 meters, whichever is larger. If there are questions regarding the homogeneity of an AU (i.e., you answered "yes" to any of the questions above) then a hydrology evaluation should be performed on multiple sample reaches to identify potential transition point(s) between flow categories and accurately characterize the AU. One approach may be to examine air photos or satellite imagery and identify those areas with the greatest vegetation as potential study reaches with the greatest likelihood for "perennial" characteristics. Using the tools and resources described above may be helpful in confirming characteristics on the ground should an AU need to be re-evaluated.

2. Level 1 Field Procedures

In order to distinguish between ephemeral, intermittent, and perennial streams and rivers using the information presented in this protocol, the field evaluator should have experience making geomorphic, hydrological, and biological observations in New Mexico or the semi-arid region of the southwestern U.S. Field evaluations should be performed at least 48 hours after the last known major rainfall or snowmelt event. In addition, it is *strongly* recommended that field evaluations be conducted outside of drought conditions whenever possible.

Field Equipment and Supplies

- Copy of *Hydrology Protocol* and associated *Field Sheets*.
- Site maps and satellite imagery (1:250 scale if possible)
- Global Positioning System (GPS) – used to determine latitude and longitude
- Clipboard/pencils/sharpies
- Two Metric Rulers
- Two Measuring Tapes
- Survey rod
- Bank pins
- Laser Level/Rod Eyes/Clinometer
- Compass (if not available as part of GPS unit)
- Camera – used to photograph and document site features
- Shovel or Soil Auger
- D-frame dip net/white sorting tray (optional) Munsell
- Soil color chart (optional)
- Long piece of string (optional)
- Mechanical tally counter (optional)
- Sand-gauge card (optional)

Sample Reach Selection

Before selecting a location for the survey, note the character of the stream while driving to the site to verify that the reach is representative of the AU being characterized. This initial examination allows the evaluator to study the nature of the channel, observe characteristics of the watershed, and observe characteristics that indicate what source of water (stormflow, or base flow plus tributary/point source discharges, if present) may predominantly or solely contribute to flow in the AU. These initial observations also aid in determining the magnitude (poor, weak, moderate or strong) of specific parameters. In addition, the assessor can identify if the sample reach is generally uniform (i.e. "representative") or if it should be assessed as two or more distinct reaches. Hydrology evaluations must not be made at one point without first walking up and down the channel for at least 160 meters.

Ideally, the visual examination would be from the stream origin to the downstream confluence with a larger stream or until a change in characteristics such as slope or geology is observed, but this is usually not feasible or practical. Furthermore, property access issues may arise on privately held property. Make sure the site is easily and safely accessible. If the site is on private property get the land owner's approval before conducting an evaluation.

Upon finding a representative area to conduct the survey, document the latitude and longitude (origination and termination) extent of the survey reach on the *Field Sheets*, the length of the survey area should be no less than 160 meters.

Photodocumentation

It is important to explain the rationale behind any conclusions reached using this protocol and sometimes photos are just the medium in which to do that. It is essential to take several photos of the sample reach, AU and/or watershed, as appropriate, to document the environmental conditions and any disturbances or modifications that are relevant to making a final hydrology determination. Multiple and varied photos will help evaluate and verify the homogeneity of the AU as well as the representativeness of the sample reach when and if a UAA is reviewed by NMED, EPA and the WQCC. Photos that document the evaluation attributes (e.g. riparian vegetation, benthic macroinvertebrates, etc.) are also encouraged and provide excellent supporting documentation for any conclusions reached.

The assessor should include a detailed description of each photo on the *Field Sheets*, including date, description of the photo (e.g. left bank, right bank, upstream, downstream, etc.), and GPS coordinates (if different from site location), and attach the photos to the *Field Sheets* to officially document the conditions at the time of the evaluation and to support any conclusions that were reached using this protocol.

3. Level 1 Scoring

Hydrological determinations are accomplished by evaluating 14 different attributes of the sample reach and assigning a numeric score to each attribute following the four–tiered, weighted scale described in Section 1 Scoring and summarized in Table 1. Total scores reflect the persistence of water with higher scores indicating intermittent and perennial systems. **Please see Section 2 – Guidance for Overall Score Interpretation for more details.**

4. Level 1 Indicators

1.1. Water in Channel

It is necessary to distinguish stormwater inflow (resulting from precipitation within the past 48 hours) from baseflow. Flow observations preferably should be taken at least 48 hours after the last substantial rainfall or runoff event. Local weather data and drought information should be reviewed before evaluating flow conditions. Perennial systems will have water in their channels year-round in the absence of drought conditions. Therefore, it is recommended that field evaluations be conducted outside of drought conditions whenever possible. Drought conditions are defined as any time the Standard Precipitation Index (SPI) is less than -1.5, indicating severely to extremely dry conditions (NDMC 1995). The 12-month SPI should be recorded on the *Field Sheets* to indicate climatic conditions at the time of sampling, and confirmed through other sources such as the Standardized Precipitation Evapotranspiration Index (Beguería, et al. 2014) or the United States Drought Monitor to ensure that extreme conditions are not indicated for the survey location.

Evidence of recent high flows should be noted on the *Field Sheets*. Such evidence includes moist or wet sediment on plants or debris and organic drift lines at or above bankfull or in the active floodplain. Artificial (i.e. point-source) discharges should also be noted on form. Site inspections should result in visually discernible stream flows as evidence of base flow contribution between rain events, even in low flow conditions. If base flows are present during a site inspection that is more than 48 hours after a major rainfall or runoff event, the sample reach is either perennial or intermittent. However, intermittent reaches do not always have water in them. A good rule of thumb for differentiating ephemeral reaches from intermittent ones is if they have water in them during the dry season or during a drought. Look for water in pool areas in the streambed. The presence or types of plants as well as saturated sediment underneath rocks located within the channel are also good indications of the presence of water during the dry season or during a drought.

If the stream is visited during the dry season (typically defined in NM as **late May to mid-July** and **mid-September to early November**, but also varies by region and elevation of the stream) and base flows are not evident, the stream may be ephemeral or intermittent. If there is no flowing water within 48 hours of a rain or runoff event, then the stream is more than likely ephemeral. The prerequisite for a stream to be determined as ephemeral is that there must be no evidence of base flows in the stream banks.

- *Strong* – Flow is evident throughout the sample reach. Moving water is seen in riffle areas but may not be as evident throughout the runs.
- *Moderate* – Water is present in the channel but flow is barely discernable in areas of greatest gradient change (i.e. riffles) or floating object is necessary to observe flow.
- *Weak* – Dry channel with standing pools. There is some evidence of base flows (e.g. riparian vegetation growing along channel, saturated sediment under rocks, etc)
- *Poor* – Dry channel. Dry under rocks and debris. No evidence of base flows was found.

If available, historic or recent flow data from streamgages such as those managed by the USGS, OSE, or LANL may clearly indicate ephemeral, intermittent, or perennial flow patterns for the available period of record and will facilitate the scoring of Indicator #1.1 *Water in Channel*.

1.2. Fish (qualitative observations)
In most cases, fish are indicators of perennial systems, since fish will rarely inhabit an intermittent stream. Fluctuating water levels of intermittent streams provide unstable and stressful habitat conditions for fish communities. When looking for fish, all available habitats should be observed, including pools, riffles, root clumps, and other obstructions (to greatly reduce surface glare, the use of polarized sunglasses is recommended). In small streams, the majority of species usually inhabit pools and runs. Fish should be easily observed within a minute or two. Also, fish will seek cover once alerted to your presence, so be sure to look for them slightly ahead of where you are walking. Check several areas along the sample reach, especially underneath undercut banks.

Strong - Found easily and consistently throughout the sample reach.
Moderate - Found with little difficulty but not consistently throughout the sample reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Poor - Fish are not present (after 10 or more minutes of searching).

1.3. Benthic Macroinvertebrates (qualitative observations)
The larval stages of many aquatic insects are good indicators that a stream is perennial because a continuous aquatic habitat is required for these species to mature. Turn over the rocks and other large substrate found in areas of visible flowing water, (i.e. riffles) and scan the undersides for benthic macroinvertebrates. Also observe the newly disturbed area where the rock once was for signs of movement. This method may be more suitable for mountainous areas where riffles predominate. For lower gradient systems and other areas of slow moving water, benthic macroinvertebrates may be located in a variety of habitats including root wads, undercut banks, pools, leaf-packs, and submerged aquatic vegetation. Note that some benthic macroinvertebrates will make small debris/sand cases, which can be covered with periphyton and easily confused for
excess debris picked up from the substrate. The use of a small net to sample a variety of habitats
including water under overhanging banks or roots, accumulations of organic debris (e.g. leaves) and the substrate may be helpful.

<u>*In DRY channels*</u>, focus the search on the sandy channel margins for mussel and aquatic snail shells, any remaining pools for macroinvertebrates, and under cobbles and other larger bed materials for caddisfly casings. Casings of emergent mayflies or stoneflies may be observed on dry cobbles or on stream-side vegetation.

Strong - Found easily and consistently throughout the sample reach.
Moderate - Found with little difficulty but not consistently throughout the sample reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Poor - Benthic macroinvertebrates are not present (after 10 or more minutes of searching).

1.4. Presence of Filamentous Algae and Periphyton (qualitative observations)
These forms of algae are attached to the streambed substrate and require an aquatic environment to persist. They are visible as a pigmented mass or film, or sometimes hair-

like growths on submerged surfaces of rocks, logs, plants and any other structures within the channel. Periphyton growth is influenced by chemical disturbances such as increased nutrient (nitrogen or phosphorus) inputs and physical disturbances such as increased sunlight to the stream from riparian zone disturbances.

Strong - Found easily and consistently throughout the sample reach.
Moderate - Found with little difficulty but not consistently throughout the sample reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Poor - Filamentous algae and/or periphyton are not present (after 10 or more minutes of searching).

1.5. Differences in Vegetation

As a rule, only perennial and intermittent systems can support riparian areas that serve the entire suite of riparian ecological functions. Ephemeral streams generally do not possess the hydrological conditions that allow true riparian vegetation to grow. Although water flows down ephemeral channels periodically, the water table does not occur sufficiently close to the soil surface to allow water loving vegetation to access the greater quantity of water they need to grow. Vegetation growing along ephemeral watercourses may occur in greater densities or grow more vigorously than vegetation in the adjacent uplands, but generally there are no dramatic compositional differences between the two. Even along those ephemeral channels where vegetation composition differs somewhat from the adjacent uplands, that vegetation does not require as much soil moisture as true riparian plants.

Note if vegetation is absent or altered due to man-made activities on the Level 1 *Field Sheet*

Strong – Dramatic compositional differences in vegetation are present between the riparian corridor and the adjacent uplands. A distinct riparian vegetation corridor exists along the entire sample reach – riparian, aquatic, or wetland species dominate the length of the reach.
Moderate – A distinct riparian vegetation corridor exists along part of the sample reach. Compositional species difference between upland and riparian corridor. Riparian vegetation is interspersed with upland vegetation along the length of the reach.
Weak – Vegetation growing along the sample reach may occur in greater densities or grow more vigorously than in the adjacent uplands, but there are minimal compositional differences between the two.
Poor – No compositional or density differences in vegetation are present between the banks and the adjacent uplands. Vegetation growing along the riparian area does not occur in greater density or grow more vigorously than in the adjacent uplands.

1.6. Absence of Rooted Upland Plants in Streambed

This attribute relates flow to the absence of rooted plants, since flow will often act as a deterrent to plant establishment by removing seeds or preventing aeration to roots. Cases where rooted upland plants are present in the streambed may indicate ephemeral or intermittent flow. Focus should be on the presence of plants in the bed or thalweg and plants growing on any part of the bank should not be considered. Note, however, there will be exceptions to this attribute. For example, rooted plants can be found in shaded perennial streams with moderate flow but in all cases these plants will be water tolerant (i.e. obligate and/or facultative wetland plants).

Additionally, in some situations (e.g., high gradient sand bedded streams located within flashy watersheds) highly erosive flows and/or depth of scour in response to extreme rainfall events may limit the presence of rooted vegetation. Under these circumstances the assessor may use

professional judgment in selecting the appropriate scoring criteria, and should document on the

Field Sheets and with photos those factors that explain any alternative scoring methodology.

Strong – Rooted upland plants are absent within the streambed/thalweg.
Moderate – There are a few rooted upland plants present within the streambed/thalweg.
Weak – Rooted upland plants are consistently dispersed throughout the streambed/thalweg.
Poor – Rooted upland plants are prevalent within the streambed/thalweg.

*** If the sample reach being evaluated has a score ≤ 2 up to this point, the reach is determined to be ephemeral. If the reach being evaluated has a score≥ 18 at this point, the reach is determined to be perennial. You can STOP the evaluation. However, if the reach has a score between 2 and 18 you should continue the Level 1 Evaluation.***

1.7. Sinuosity

Sinuosity is a measure of a channel's "crookedness." Sinuosity is the result of the stream naturally dissipating its flow forces. Intermittent systems don't have a constant flow regime and, as a result, exhibit substantially less sinuous channel morphology. While ranking, take into consideration the size of the stream (e.g. 1st, 2nd, 3rd order, etc.), which may also influence the stream sinuosity. Sinuosity is best measured using aerial photography (Rosgen 1996).

Examples of sinuosity are provided in Figure 1. To calculate sinuosity using an aerial photograph, measure the stream length and related valley length for at least two meander wavelengths. A meander wavelength is the distance of one meander, or bend, along the down- valley axis of the stream. Divide the *stream* length (SL) by the *valley* length (VL) (Figure 2). If aerial photos are not available, sinuosity can be measured using a GPS's trip computer function to measure channel length and valley length. The higher the ratio (SL/VL), the more sinuous the stream.

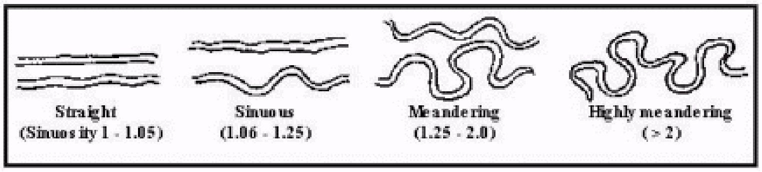


Figure 1. Examples of Stream Sinuosity (NCDWQ 2005)

In some surface waters (e.g., mountain stream settings or areas of complex and varied geology) channel sinuosity may be more reflective of external morphological factors, rather than the presence or absence of stream flow. Under these circumstances the assessor may use professional judgment in selecting the appropriate scoring criteria, and should document on the Level 1 *Field Sheets* and with photos those factors that explain any alternative scoring methodology.

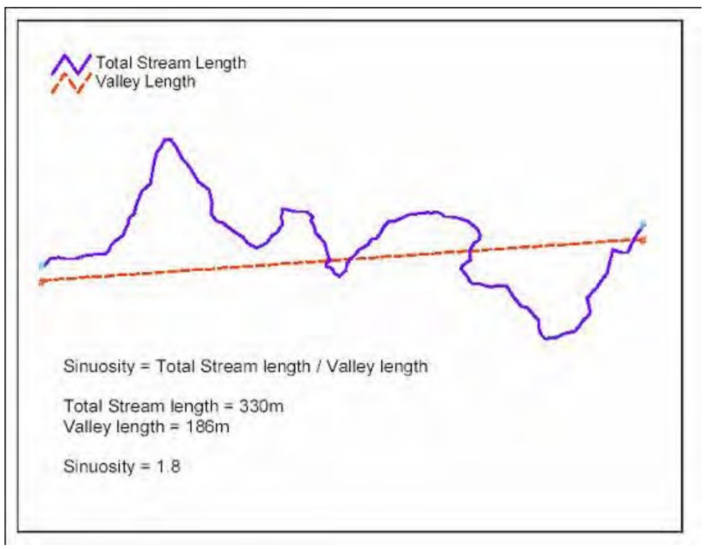


Figure 2. Stream Sinuosity (NCDWQ 2005)

******Note method used to determine sinuosity on the Field Sheets******

Strong – Stream sinuosity ratio is greater than 1.4. Stream has numerous, closely-spaced bends, few straight sections.

Moderate – Stream sinuosity ratio is between 1.4 and 1.2. Stream has good sinuosity with some straight sections.

Weak – Stream sinuosity ratio is between 1.2 and 1.0. Stream has very few bends and mostly straight sections.

Poor – Stream sinuosity ratio is equal to 1.0. Stream is completely straight with no bends.

1.8. Floodplain and Channel Dimensions

The relative importance of many fluvial processes in arid regions, especially the magnitude and frequency of their operation, differs considerably from more humid regions. As a result, channel forms also differ considerably from humid regions. Although one of the difficulties of characterizing dryland ephemeral streams is their enormous variability in form, they tend to be more incised with confined channels relative to intermittent and perennial streams (Knight et al. 1999).

When determining the vertical confinement of the stream, it is important to distinguish whether the flats adjacent to the channel are a frequent and active floodplain, terraces (abandoned floodplain), or are well outside of the flood-prone area. The ratio of the flood-prone area width to the bankfull, or active, channel width is used to determine the vertical confinement of the stream (Rosgen 1994). A larger ratio corresponds to a wide, active floodplain and a minimally confined channel, whereas a smaller ratio corresponds to a narrow or absent floodplain and a noticeably confined channel (**see scoring and "note" below*).

The flood-prone area width is measured at the elevation that corresponds to twice the maximum depth of the bankfull channel as taken from the established bankfull stage (Figure 3). The bankfull, or active, channel is defined as that which is filled with moderate sized flood events that would typically occur every one or two years and do not usually inundate the floodplain. Bankfull levels can be identified by:

- The presence of a floodplain at the elevation of initial flooding,
- The elevation associated with the *highest* depositional features,
- An obvious slope break that differentiates the channel from a relatively flat floodplain terrace higher than the channel,
- A transition from exposed sediments to terrestrial vegetation,
- Moss growth on rocks along the banks,
- Evidence of recent flooding,
- Presence of drift material caught on overhanging vegetation, and
- Transition from flood- and scour-tolerant vegetation to that which is relatively intolerant.

Field Protocol:

The evaluator(s) should start by selecting a location for the purpose of obtaining bankfull data. In general, the easiest location to measure bankfull channel width is within the narrowest segment of the sample reach. Deflectors such as rocks, logs, or unusual constrictions that make a stream especially narrow should be avoided.

1. Once a location is chosen, obtain a *rod reading* for an elevation at the "max depth" location by having one person hold a survey rod at the max depth location (thalweg) and a second person on the terrace adjacent to the stream using a clinometer and a meter stick or ski pole with one meter marked on it (if available, a surveyor's level can be used instead of a clinometer). Hold the clinometer at the one-meter mark on the ski pole, look through the clinometer holding it at zero, and read the height on the survey rod at the "max depth" location (Refer to **Figure 3**). Record the "max depth" *rod reading* on *Level 1 Field Sheets*.
2. Identify the bankfull stage using the indicators described above. Obtain a *rod reading* for an elevation at the "bankfull stage" location using the methods described in Step #1. Record the "bankfull stage" *rod reading* on Level 1 *Field Sheets*.
3. Subtract the "bankfull stage" reading from the "max depth" reading to obtain a maximum depth value. Multiply the maximum depth value by 2 for the "2x Max.

Depth" value. Record the "2x Max. Depth" value on Level 1 *Field Sheets*.

4. Subtract the "2x Max Depth" value from the "max depth" *rod reading* for the "flood- prone area" location *rod reading*. Move the rod upslope, online with the cross-section, until a rod reading for the "flood-prone area" location is obtained.
5. Mark the flood-prone area (FPA) locations on each bank. Measure the distance between the two FPA locations. Record the **FPA Width** on Level 1 *Field Sheets*.
6. Measure the distance between the two Bankfull Stage locations. Record the **Bankfull Width** on Level 1 *Field Sheets*.
7. Divide the FPA Width by the Bankfull Width to calculate the Floodplain to Channel Ratio. Record the calculated ratio on Level 1 *Field Sheets*. <u>The Floodplain to Channel Ratio is used to score the stream for this indicator</u>.

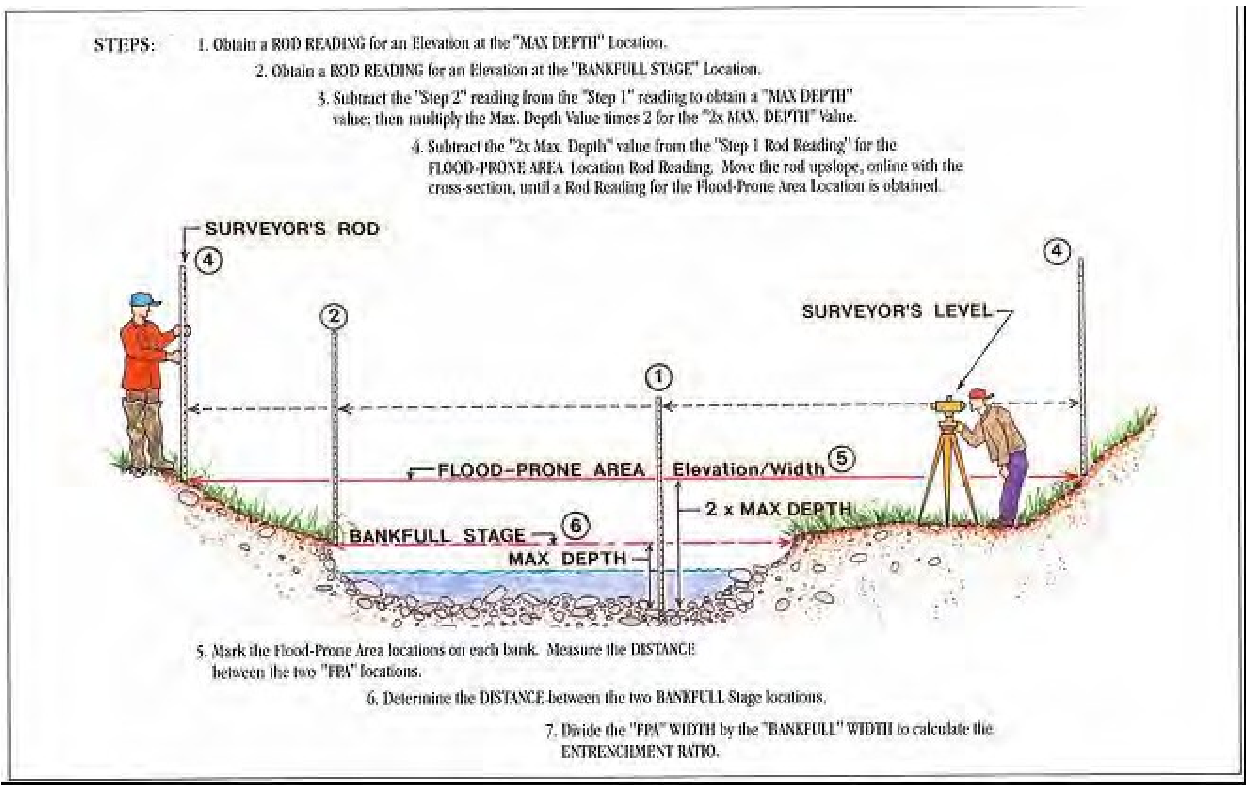


Figure 3. Determining a Flood-Prone Area elevation/width (Rosgen 1996)

In some surface waters (e.g., mountain stream settings or areas of complex and varied geology) the degree of channel confinement may be more reflective of external morphological factors rather than the presence or absence of stream flow. Under these circumstances the assessor may use professional judgment in selecting the appropriate survey location and scoring criteria and should document on the Level 1 *Field Sheets* and with photos those factors that explain the resulting 'representative' scores.

******Alternative methods for determining the Floodplain to Active Channel Ratio should be described and recorded on the Field Sheets******

Strong - Ratio > 2.5*. Stream is minimally confined with a wide, active floodplain.

Moderate - Ratio between 1.2 and 2.5. Stream is moderately confined. Floodplain is present but may only be active during larger storm events.

Weak - Ratio < 1.2. Stream is incised with a noticeably confined channel. Floodplain is narrow or absent and disconnected from the channel during most storm events.

*NOTE**:** a larger ratio corresponds to a wide, active floodplain and a minimally confined channel, while a smaller ratio corresponds to a narrow or absent floodplain and a noticeably confined channel. If the channel is dry and bankfull stage cannot be determined, score this indicator based on your observations using the following scoring system:

Strong = stream is not incised/confined. Wide, active floodplain is connected to the channel.

Moderate = stream is moderately incised/confined. Flood-prone area width is narrow. Floodplain adjacent to the channel may be connected during large floods or represented by abandoned terraces.

Weak = stream is undeniably incised/confined. Flats adjacent to the stream are well outside of the flood-prone area.

1.9. In-channel Structure -- Riffle-Pool Sequences

A repeating sequence of riffle/pool (riffle/run in lower gradient systems, ripple/pool in sand bed systems, or step/pool in higher gradient systems) can be observed readily in perennial systems. Riffle-run (or ripple-run) sequences in low gradient systems are often created by in-channel woody structures such as roots and woody debris. When present, these characteristics can be observed even in a dry channel by closely examining the local profile of the channel. A riffle is a zone with relatively high channel slope gradient, shallow water, and high flow velocity and turbulence. In smaller streams, riffles are defined as areas of a distinct change in gradient where flowing water can be observed. The bottom substrate material in riffles contains the largest sedimentary particles that are moved by bankfull flow (bedload). A pool is a zone with relatively low channel slope gradient, deep water, and low velocity and turbulence. Fine textured sediments generally dominate the bottom substrate material in pools. Along the sample reach, take notice of the frequency between the riffles and pools.

Strong - Demonstrated by a frequent number of riffles followed by pools along the entire sample reach. There is an obvious transition between riffles and pools.

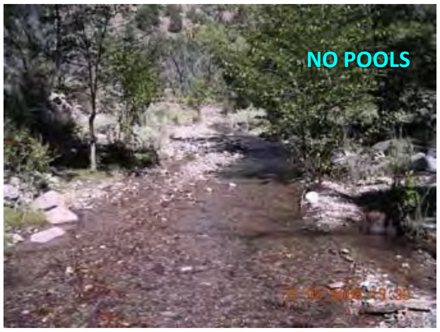
Moderate - Represented by a less frequent number of riffles and pools. Distinguishing the transition between riffles and pools is difficult.

Weak - Mostly has areas of pools or of riffles.

Poor - No riffles or pools observed.

Example of “**Strong**” Score – San Francisco River

Example of “**Moderate**” Score – Santa Fe River



Example of “**Weak**” Score – Mineral Creek

Example of “**Poor**” Score – Arroyo Chamiso

*** If the sample reach being evaluated has a score ≤ 5 at this point, the reach is determined to be ephemeral. If the reach being evaluated has a score ≥ 21 at this point, the reach is determined to be perennial. You can STOP the evaluation. However, if the reach has a score between 5 and 21 you should continue the Level 1 Evaluation.***

1.10. Particle size or Stream Substrate Sorting

This feature can be examined in two ways. The first is to determine if the sediment texture in the bottom of the channel is similar to the texture outside the channel. If this is the case, then there is evidence that erosive forces have not been active enough to down cut the channel and support an intermittent or perennial system. Sediment in the bed of ephemeral channels typically have the same or comparable texture (i.e. particle size) as areas close to but not in the channel. Accelerated stormflow resulting from human activities may produce deep, well-developed ephemeral or intermittent channels which have little or no coarse bottom materials indicative of upstream erosion and downstream transport. The bottom substrate of non-ephemeral systems often has accumulations of coarse sand and larger particles.

The second way this feature can be examined is to look at the distribution of the particles in the substrate in the channel. In lower-gradient, sand-bed streams one may need to look for size variations among sand grains – for instance, coarse versus fine sand. Note, however, the usefulness of this attribute may vary among ecoregions. For instance, in the plateaus or tablelands the variability in the size of substrate particles will probably be less than in the mountains.

Examples of Methods used to determine particle size and gradation:

- Sand Gauge Reference Card (best for sand dominated systems)
- Standard Sieve Analyses
- Wire Screen Method
- Pebble Count Method:
  - EPA's EMAP Pebble Count
  - Wolman Pebble Count
  - Zig Zag Pebble Count
  - USFS Pebble Count Sampling Frame

For whatever method is chosen, repeat procedure for an area close to but not in the channel for comparison purposes. Step outside the bankfull width or above the bank onto the floodplain or first terrace and repeat the procedure used in the bankfull channel. Avoid areas of dense vegetation and soil accumulation. Beware of cactus, snakes, and other hazards when "blindly" picking up particles outside of the channel or even in dry streambeds. For pebble counts, the objective is to measure at least 50 pebbles in the channel and 50 pebbles in areas close to but not in the channel for accurate distributional representations and comparisons.

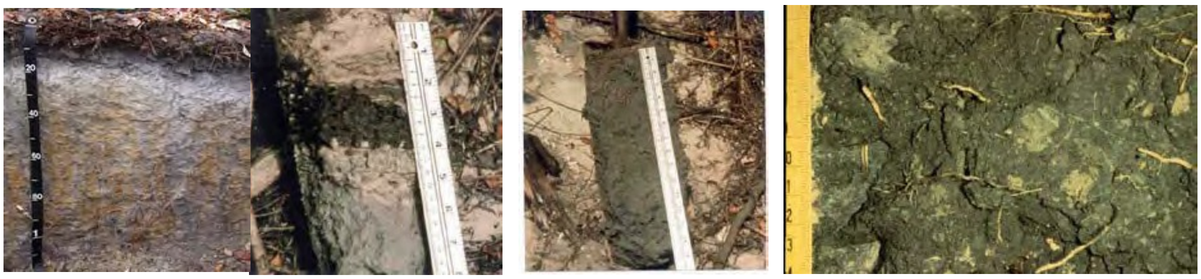
Strong - Particle sizes in the channel are noticeably different from particle sizes outside the channel in the flood-prone area. There is a clear distribution of various sized substrates in the channel with finer particles accumulating in the pools, and larger particles accumulating in the riffles/runs.

Moderate - Particle sizes in the channel are moderately similar to particle sizes outside the channel in the flood-prone area. Various sized substrates are present in the channel and are represented by a higher ratio of larger particles (gravel/cobble).

Weak - Particle sizes in the channel are similar or comparable to particle sizes outside the channel in the flood-prone area. Substrate sorting is not readily observed in the channel.

1.11. Hydric Soils

One of the most reliable methods for differentiating between ephemeral and non-ephemeral stream types during drier conditions requires investigation of the stream bank (i.e. from the stream bed to the top of the bank). Ephemeral streams usually have poor channel development and lack groundwater-induced base flows that normally result in hydric soils dominating the banks of intermittent and perennial streams. The presence of hydric soil indicators above the elevation of the channel bottom in floodplain soils adjacent to the channel indicates the presence of a seasonal high water table that can provide a critical period of base flow. Non-ephemeral stream banks typically are dominated by soils with hydric indicators, such as visually confirmed oxidized rhizospheres, a matrix of gray or black soils, and reducing conditions confirmed by a redox meter. The presence of hydric soils should be determined through visual observations, pungent odors, clay, etc. Additional information on field indicators of hydric soils is available from the Natural Resources Conservation Service at https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/. There are also special considerations regarding the determination of hydric soils in arid regions. The United States Army Corps of Engineers (USACE) Wetlands Regulatory Assistance Program has divided New Mexico into three regions (Arid West, Western Mountains, and Great Plains). A regional map and regional supplements to the Corps of Engineers Wetland Delineation Manual are available at: https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/reg_supp.



Examples of Hydric Soils in the Arid West – U.S. Army Corps of Engineers
(photos found at: http://www.usace.army.mil/CECW/Documents/cecwo/reg/trel08-28.pdf)

Note that hydric soil indicators may be poorly developed at the seasonal high-water table elevation in young, coarse textured, alluvial soil materials with low concentrations of clay, iron, and manganese, or floodplain soils where moving water fails to become reduced.

Present – Hydric soils are found within the sample reach.
Absent – Hydric soils are not found within the sample reach.

1.12. Sediment on Plants or Debris

The transportation and processing of sediment is a main function of streams. Therefore, evidence of sediment on plants or other debris in the channel may be an important indicator of recent high flows. Note that sediment production in stable, vegetated watersheds is considerably less than in disturbed watersheds. Are plants in the channel, on the streambank, or in the floodplain covered with sediment? Look for silt/sand accumulating in thin layers on debris or rooted aquatic vegetation in the runs and pools. Be aware of upstream land-disturbing construction activities, which may contribute greater amounts of sediments to the channel and can confound this indicator. Note these activities on the *Field Sheets* if these confounding factors are present.

Strong – Sediment found readily on plants and debris within the channel, on the streambank, and within the floodplain throughout the length of the sample reach.
Moderate – Sediment found on plants or debris within the channel although not prevalent along the sample reach. Mostly accumulated on plants and debris in pools.
Weak – Sediment on plants and debris is isolated in small amounts along the sample reach.
Poor – No sediment is present on plants or debris.

****Refer to Section 2 Overall Score Interpretation, for guidance on overall Level 1 score interpretation****

Level 1 Supplemental Indicators

The following indicators do not occur consistently throughout New Mexico, which may be the reason why they were not statistically significant between waterbody types. Regardless, when they occur they are useful indicators in the determination of perenniality. Record the score on the Level 1 *Field Sheets* and include the score when calculating the total points.

1.13. Seeps and Springs

Seeps: Seeps have water dripping or slowly flowing out from the ground or from the side of a hill or incised streambank. Springs: Look for "mushy" or very wet, black decomposing leaf litter nearby in small depressions or in the channel. Springs and seeps often are present at grade controls and headcuts. The presence of this indicator suggests that groundwater is a source of streamflow except during a period of drought. Score this category based on the presence or absence of these features observed within the sample reach.

Present – Seeps and/or springs present in reach.
Absent – Seeps and/or springs were not present in reach

1.14. Iron Oxidizing Bacteria/Fungi

These features are often (although not exclusively) associated with groundwater. Iron oxidizing bacteria/fungi derive energy by oxidizing iron, originating from groundwater, in the ferrous form (Fe^{2+}) to the ferric form (Fe^{3+}). In large amounts, iron-oxidizing bacteria/fungi discolor the substrate giving it a red, rust-colored appearance. In small amounts, it can be observed as an oily sheen on the water's surface. This indicates that the stream water is derived from a groundwater source, and these features are most commonly seen in standing water on the ground's surface or in slow moving creeks and streams. Filmy deposits on the surface or banks of a stream are often associated with the greasy "rainbow" appearance of iron oxidizing bacteria. This is a naturally occurring phenomenon where there is iron in the groundwater. However, a sudden or unusual occurrence may indicate a petroleum product release from an underground fuel storage tank. One way to differentiate iron-oxidizing bacteria from oil releases is to trail a small stick or leaf through the film. If the film breaks up into small islands or clusters, it is most likely bacterial in origin. However, if the film swirls back together, it is most likely a petroleum discharge.

Present – Iron-oxidizing bacteria/fungi present in reach.
Absent – Iron-oxidizing bacteria/fungi not present in reach.

Oily sheen on water's surface due to iron-oxidizing bacteria
(photos found at:
http://www.arlingtonva.us/departments/EnvironmentalServices/epo/EnvironmentalServicesEpoDr.aspx)

Iron-oxidizing bacteria in seepage spring at La Plata River, Farmington, NM

****Refer to Section 2 Overall Score Interpretation, for guidance on overall Level 1 score interpretation****

G. Level 2 Evaluation: Borderline Determinations

If, after conducting a Level 1 Evaluation, a hydrological determination cannot be made because more information is required, then a Level 2 Evaluation should be conducted between mid-August and mid-November to coincide with SWQB's biological index period.

1. Level 2 Office Procedures

Refer to the results of the **Level 1 Evaluation**. If this step was not completed in the Level 1 Evaluation or cannot be located then refer to *Drought Conditions* and *Recent Rainfall Activity* and the *Level 1 Office Procedures*, particularly *Stream Segment Identification and Sample Reach Selection*, for more information.

Additional Supporting Information

Additional supporting information may not be scored but can be used to support a Level 2 hydrological determination. Unfortunately, not all information listed here will be available for every assessment unit. Additional supporting information includes, but is not limited to:

Observation of flow:

Observation of flow under certain seasonal or hydrological conditions can directly support classifying a sample reach as perennial. Reaches with flow during the dry season or periods of drought are likely perennial. Although the presence of flow during a drought indicates perennial conditions, care must be taken in evaluating the upper limits of perenniality because some perennial systems may only contain isolated pools of water or be dry during periods of drought.

Thermograph Data:

- Historic or recent SWQB thermograph data may provide some insight on flow during certain seasonal or hydrological conditions
- Do thermograph and/or streamflow data (or lack thereof) warrant the use of equipment to estimate the onset and cessation of flow? (See *Indicator #2.1* below)

Key biological indicators:

As discussed below, the presence of aquatic organisms whose life cycle requires residency in flowing water for extended periods (especially those one year or greater) is a strong indication that a sample reach is perennial. If a reach is recognized as borderline, a qualified aquatic biologist or environmental scientist should evaluate the presence and abundance of such macroinvertebrates and vertebrates species before making a final hydrological determination.

- Current and/or historic fisheries data may be found at:
  - Natural Heritage New Mexico (https://nhnm.unm.edu/)
  - Museum of SW Biology (http://www.msb.unm.edu/index.html)
  - Sublette, James E. et al. 1990. *The Fishes of New Mexico – First Edition.* University of New Mexico Press. 393 p.
- SWQB Fisheries Data are available upon request by contacting the Surface Water Quality Bureau (505-827-0187 or https://www.env.nm.gov/surface-water-quality/).

Other information that may be considered:

- Groundwater contour maps and/or nearby, local well logs.
- Information provided by a long-term resident and/or local professional who has observed the stream during various seasons and hydrological conditions.
- Review of historic information such as aerial photography.
- Professional judgment may be used in conjunction with the total score and supporting information in making the final determination.

2. **Level 2 Field Procedures**

In order to distinguish between ephemeral, intermittent, and perennial streams and rivers using the information presented in this protocol, the field evaluator should have experience making geomorphic, hydrological, and biological observations in New Mexico or the semi-arid region of the southwestern U.S. Field evaluations should be performed at least 48 hours after the last known major rainfall event or snowmelt. In addition, it is *strongly* recommended that field evaluations be conducted outside of drought conditions whenever possible. Drought conditions, for the purposes of this *Hydrology Protocol*, are defined as any time the 12-month SPI is less than -1.5, indicating severely to extremely dry conditions (NDMC 1995).

Refer to the results of the **Level 1 Evaluation**. If this step was not completed in the Level 1 Evaluation or cannot be located then refer to the *Level 1 Field Procedures*, specifically *Sample Reach Selection* and *Photodocumentation,* for more information.

Level 2 Field Equipment and Supplies

Copy of *Hydrology Protocol* and associated *Field Sheets*
*Thermograph Deployment/Upload/Retrieval Field Sheet
*Fish Sampling Field Data Sheet
Site maps and aerial photographs (1:250 scale if possible)
Global Positioning System (GPS) –
used to determine latitude and longitude
Camera and Compass –
used to photograph and document site features
Clipboard/pencils/sharpies
Measuring tape
Survey flags for transect locations
Survey rod
Bank pins
Level
Shovel or Soil Auger
Thermographs with caps and tags
Zip ties/bailing wire
Hammer & T-post driver
Rebar & T-posts (various lengths)
Flagging
Wire/tie cutters
Kicknet (18 inch; 500µm net size)
Forceps
Sieve (500µm mesh)
Buckets –
to help sort macroinvertebrates
Sample containers (500-mL or 1-L)
Ethanol
Ethanol-proof sample labels
Ethanol-proof pen
Timepiece
Backpack electrofisher & accessories
Seine net
Buckets & aerators
Dip & aquarium nets
Voucher kit & formalin
Field guide
Collection permits
Measuring Board
One battery per site –
for electrofisher + back-up

*See the SWQB SOP webpage at https://www.env.nm.gov/surface-water-quality/sop for the current version

3. **Level 2 Indicators**

2.1. Water in Channel (OPTIONAL)

Observation of flow under certain seasonal or hydrological conditions can directly support classifying a sample reach as perennial. Reaches with flow during the dry season or periods of drought are likely perennial. The longer the period from the last substantial rainfall the stronger the presence of flow supports the perennial determination. Although the presence of flow during a drought indicates perennial conditions, care must be taken in evaluating the upper limits of perenniality because some perennial systems may only contain isolated pools of water or be dry during periods of drought.

If available, historic or recent flow data from streamgages such as those managed by the USGS, OSE or LANL may clearly indicate ephemeral, intermittent, or perennial flow patterns for the available period of record and will facilitate the scoring of this indicator. If streamgage data are not available, temperature sensors (or electrical resistance sensors or pressure transducers) can be used to estimate the onset and cessation of flow (Constanz et al. 2001; Lawler 2002; Blasch et al. 2002). Periods of flow are characterized by those sections of the thermograph where the amplitude of the diel temperature signal is visibly dampened (Constanz et al. 2001). When the in-stream temperature data are compared graphically to the temperature data from a nearby site out of streamflow where little dampening has occurred, a flow signal is easily identifiable.

Strong – The water sensor is decidedly different from the air sensor. The streamflow signal is easily identifiable and occurs throughout the entire time of deployment (i.e. water sensor has a diel signal that is visibly dampened compared to air sensor throughout the deployment).

Moderate – The water sensor differs from the air sensor. A flow signal is identifiable during the majority of time; however, there are short periods of time when the water sensor has a diel signal that is comparable to the air sensor indicating periods of drying.

Weak – The water sensor differs somewhat from the air sensor. A flow signal is identifiable during certain days or weeks; however, there are long periods of time when the water and air sensors have similar diel signals (i.e. no dampening) indicating dry periods.

Poor – There are no substantial differences between the water and air sensors. The two thermographs are visibly comparable to one another indicating little to no water in the channel.

**If using an electrical resistance sensor or pressure transducer, use the following ratings:

Strong – The streamflow signal is easily identifiable and occurs throughout the entire time of deployment

Moderate – A streamflow signal is identifiable during the majority of time; however, there are short periods of time when the sensor indicates periods of drying.

Weak – A streamflow signal is identifiable during certain weeks or months; however, there are long periods of time when the sensor indicates a dry channel.

Poor – There is no sustained streamflow signal from the sensor (flow signal is only for very brief periods of time – on the timescale of days – indicating a flow response due to storm events). Or there is no discernible streamflow signal.

2.2. Hyporheic Zone/Groundwater Table

Hyporheic zone: Even when there is no visible flow above the channel bottom, there may likely be slow groundwater discharge into and downstream flow in the **hyporheic zone**. The hyporheic zone is the subsurface interface beneath and adjacent to a stream or river where surface water and shallow groundwater mix. It may be recognized by the accumulation of coarse textured sediments in the bottom of the channel that may be up to 2-3 ft deep in small streams. The saturated sediment in the hyporheic zone exchanges water, nutrients, and fauna with surface flowing waters. Consequently, the hyporheic zone is the site of groundwater discharge to the stream channel, downstream flow, and biological and chemical activity associated with aquatic functions of the stream.

Indicators of a hyporheic zone can be observed by digging a bore hole in the streambed when site conditions are conducive to manually digging a bore hole. Water standing in the bore hole or saturated sediment within the bore hole indicates the presence of a hyporheic zone. If conditions are not conducive to boring a hole in the streambed, one can look under rocks. Saturated or moist sediment underneath rocks located within the channel indicates the presence of a hyporheic zone.

Groundwater Table: The presence of a seasonal high water table or groundwater discharge (i.e. seeps or springs) from the bank, above the elevation of the channel bottom, indicates a relatively reliable source of base flow to a stream. When site conditions are conducive to manually digging a bore hole, indicators of a current water table can be observed by digging a bore hole in the adjacent floodplain approximately two feet away from the streambed. The presence of water standing in the hole above the elevation of the channel bottom after waiting for at least 30 minutes (longer for clayey soils) indicates the presence of a high groundwater table.

Strong – Considerable base flow is present. Hyporheic zone and/or groundwater table is readily observable throughout sample reach.

Moderate – Some base flow is present. Hyporheic zone and/or groundwater table is present, but not abundant throughout sample reach.

Weak – Water is standing in pools and the hyporheic zone is saturated, but there is not visible flow above the channel bottom. Indicators of groundwater discharge are present but require considerable time to locate.

Poor – Little to no water in the channel. No indication of a high groundwater table or hyporheic zone.

2.3. Bivalves

Clams cannot survive outside of water, thus one should examine the streambed or look for them where plants are growing in the streambed. Also, look for empty shells washed up on the bank. Some bivalves can be pea-sized or smaller. Since clams require a fairly constant aquatic environment in order to survive, the search for bivalves can be conducted while looking for other benthic macroinvertebrates. A small net may be useful.

Present – Bivalves are found within the sample reach.

Absent – Bivalves are not found within the sample reach.

2.4. Amphibians

Salamanders and tadpoles can be found under rocks, on streambanks and on the bottom of the stream channel. They may also appear in the benthic sample. Frogs will alert you of their presence by jumping into the water for cover. Frogs and tadpoles typically inhabit the shallow, slower moving waters of the pools and near the sides of the bank. Amphibian eggs, also included as an indicator, can be located on the bottom of rocks and in or on other submerged debris. They are usually observed in gelatinous clumps or strings of eggs.

Present – Amphibians are found within the sample reach.
Absent – Amphibians are not found within the sample reach.

Any collection and identification of aquatic species should be performed by a qualified aquatic biologist, environmental scientist, or other professional.

2.5. Benthic Macroinvertebrates (quantitative observations)

The larval stages of many aquatic insects are good indicators that a stream is perennial because a continuous aquatic habitat is required for these species to mature. The Arid West Water Quality Research Project has published a final report on *Aquatic Communities of Ephemeral Stream Ecosystems* (AWWQRR 2006) that may be a useful supplement to this protocol. In addition, SWQB scientists have been looking for the presence of long-lived aquatic species as reliable determinants for perennial channels, North Carolina's Division of Water Quality has developed a list of benthic macroinvertebrate taxa that are perennial stream indicators (NCDWQ 2010) and West Virginia's Department of Environmental Protection maintains a list of macroinvertebrate species that have an extended aquatic life stage (WVDEP – Watershed Assessment Branch, (304) 926-0495). Further information on life histories of specific macroinvertebrates found through the application of this protocol can be researched, if necessary.

Examples of Methods and Equipment used to collect Benthic Macroinvertebrates:

- EPA's EMAP Protocol
- SWQB's Benthic Macroinvertebrate SOP
- Kick Net
- D-Frame Dip Net
- Rectangular Dip Net
- Surber Sampler
- Hess Sampler
- Approaches:
  - Targeted Riffle
  - Reach-Wide, Multi-Habitat
    - top/bottom of riffle, undercut banks, pools/runs, snags/roots/logs

The goal is to collect as many different kinds of aquatic macroinvertebrates from as many different habitats as necessary to ensure an accurate site assessment. Be aware that each habitat type has different sampling protocols, and some have a greater diversity of organisms than others (**Table 2**). If you have many habitats from which to choose, consider sampling from those with the most diversity. If your stream has a rocky bottom, sample at two separate riffle areas and at one other habitat. If your stream has a soft bottom or does not have riffles, collect samples at submerged logs, snags or undercut banks.

Table 2. Relative diversity of various habitat types

Habitat Type	Stream Type	Habitat
Riffles	Rocky bottom	Most diverse
Undercut banks Snags,	Rocky, soft bottoms	↓
tree roots, logs	Rocky, soft bottoms	Least diverse

Strong – More than one taxa of benthic macroinvertebrate that requires water for their entire life cycle (rheophilic taxa) are present as later instar larvae. Overall there is a balanced distribution of taxa. A list of benthic organisms that indicate perennial features are listed in **Tables 3 and 4**.

Moderate – Only one rheophilic taxon was found in the sample, however sample is diverse. Overall there is a balanced distribution of taxa.

Weak – Rheophilic taxa are not present in the sample; however other types of benthic macroinvertebrates are present. Both diversity and abundance are low or not distributed evenly.

Poor – Benthic macroinvertebrates are not present.

Table 3. Ephemeroptera, Plecoptera, and Trichoptera (EPT) perennial indicator taxa

	Ephemeroptera (Mayflies)	Plecoptera (Stoneflies)	Trichoptera (Caddisflies)
Family:	Caenidae Ephemerellidae Ephemeridae Heptageniidae	Peltoperlidae Perlidae Perlodidae	Hydropsychidae Lepidostomatidae Molannidae Odontoceridae Philopotamidae Polycentropodidae Psychomyiidae Rhyacophilidae

Table 4. Additional indicators of perennial features

	Megaloptera	Odonata	Diptera	Coleoptera	Mollusca
Family:	Corydalidae Sialidae	Aeshnidae Calopterygidae Cordulegastridae Gomphidae	Ptychopteridae	Psephenidae Elmidae	Unionidae Ancylidae Pleuroceridae
Family & *Genus*:			Tipulidae *Tipula* sp.	Dryopidae *Helichus* sp.	

2.6. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa

The larval stages of many species of these three orders require a period of at least a year, submerged in a constantly flowing aquatic environment before reaching maturity and therefore are commonly associated with perennial systems. Studies conducted by North Carolina State University have found that benthic samples collected in intermittent systems frequently display crustaceans (crayfish, isopods, and amphipods) as the dominant order (NCDWQ 2005). In sample reaches with more perennial characteristics, EPT taxa were collected. In highly urbanized areas, these indicators may be absent due to degradation and, therefore, may not be appropriate to evaluate perennial or intermittent flow conditions. These lists should be carefully evaluated (family or genus level ID) since some genera, such as the *Baetis* mayflies for example, are very short-lived in their aquatic life stages.

Present – EPT taxa are found within the sample reach.
Absent – EPT taxa are not found within the sample reach.

Any collection and identification of aquatic species should be performed by a qualified aquatic biologist, environmental scientist, or other professional.

2.7. Fish (quantitative observations)

Fluctuating water levels of intermittent systems provide unstable and stressful habitat conditions for fish communities. When looking for fish, all available habitats should be observed, including pools, riffles, root clumps, and other obstructions (to greatly reduce surface glare, the use of polarized sunglasses is recommended). In small streams, the majority of species usually inhabit pools and runs. Check several areas along the sample reach, especially underneath undercut banks. In most cases, fish are indicators of perennial systems, since fish will rarely inhabit an intermittent stream.

Fish should be collected, measured, and classified to verify if fish are present in a water body and to help confirm the appropriate hydrological determination. Best professional judgment should be exercised to determine sampling methodology (e.g. shocking, seining, etc.) and to ensure that safety concerns are addressed.

Strong – Fish are present in all habitats (riffles, pools, runs, root clumps, undercut banks, etc.). Multiple age classes are present and evenly represented. Large-bodied fish may be present.

Moderate – Fish are evident in fewer numbers with one age class dominating. Some habitat is not occupied. Large-bodied fish may be present.

Weak – Fish are not readily visible, require 10 or more minutes to locate, and are typically found within one habitat type (e.g. pools, runs). Very sparse.

Poor – Fish are not found within the sample reach.

IV. OVERALL SCORE INTERPRETATION

The final determination of whether a stream is ephemeral, intermittent, or perennial is based on a variety of information including the total score, supporting information, and professional judgment. The use of the Level 1 Evaluation should, in most cases, provide enough information to accurately distinguish between ephemeral, intermittent, and perennial systems. Scores should reflect the persistence of water with higher scores indicating intermittent and perennial systems. However, if a stream is recognized as borderline (i.e. gray zone – see **Table 5**) or if observations are made during a severe or extreme drought (12-month SPI value less than -1.5), then a Level 2 Evaluation that relies on more intensive and focused data collection can be used to make a final hydrological determination or to verify the Level 1 evaluation.

For a Level 1 Evaluation a minimum total score of 9.0 is set as a guideline to distinguish ephemeral channels from non-ephemeral ones unless there are aquatic macroinvertebrates and/or fish, in which case at least one of the Clean Water Act Section 101(a)(2) objectives is attainable and the stream is at least intermittent. In addition, a Level 1 score greater than 22.0 distinguishes perennial streams from non-perennial streams. SWQB recognizes that there is inherent variability in nature, therefore Level 1 scores between 9 and 12 may be ephemeral but will be recognized as intermittent until further data collection and analysis through a Level 2 evaluation or detailed UAA can more clearly determine that the stream is ephemeral. Similarly, Level 1 scores between 19 and 22 may be intermittent but will be recognized as perennial until further data collection and analysis indicate that the stream is intermittent. **Table 5** summarizes interpretation of Level 1 scoring. In most instances, the use of a Level 1 Evaluation should be sufficient to make a final hydrological determination. A hydrological determination does not change the designated use for a waterbody without the completion of a UAA in accordance with 40 CFR 131.10, 20.6.4.15 NMAC and the State's approved Water Quality Management Plan/Continuing Planning Process (WQMP/CPP). **If after conducting Level 1 Evaluation, a hydrological determination <u>cannot be made</u> because more information is required, then a Level 2 Evaluation which uses more intensive data collection can be conducted.**

Table 5. Summary of Level 1 Score Interpretation

Waterbody Type	Level 1 Total Score	Hydrology Determination
Ephemeral	**Less than 9.0***	**Stream is ephemeral**
≥ 9.0 and < 12.0		Stream is recognized as intermittent until further analysis indicates that the stream is ephemeral
Intermittent	**≥ 12.0 and ≤ 19.0**	**Stream is intermittent**
> 19.0 and ≤ 22.0		Stream is recognized as perennial until further analysis indicates that the stream is intermittent
Perennial	**Greater than 22.0**	**Stream is perennial**

* If there are aquatic macroinvertebrates and/or fish the stream is at least intermittent.

If a sample reach is recognized as borderline (within the gray zones), reaches upstream and downstream of the study area should be assessed to better evaluate the changes in stream classifications along a channel. Additional supporting information can be used to help make the final determination. This supporting information may include, but is not limited to:

Observation of flow: Observation of flow under certain seasonal or hydrological conditions can directly support classifying a stream reach as intermittent or perennial. Conditions supporting a perennial stream classification include:

Stream reaches with flow during the dry season or periods of drought are likely perennial. The longer the period from the last substantial rainfall the stronger the presence of flow supports the perennial stream determination. Although the presence of flow during a drought indicates perennial conditions, care must be taken in evaluating the upper limits of perenniality because some perennial streams may only contain isolated pools of water or be dry during periods of drought.

Key biological indicators: As discussed in the Level 2 Evaluation, the presence of aquatic organisms whose life cycle requires residency in flowing water for extended periods (especially those one year or greater) is a strong indication that a stream reach is perennial. If a stream or river is recognized as borderline, a qualified aquatic biologist/environmental scientist should evaluate the presence and abundance of such macroinvertebrate and vertebrate species before determining the final stream classification.

Other additional supporting information that may be considered:

- Groundwater contour maps or nearby, local well logs.
- Information provided by a long-term resident and/or local professional who has observed the stream during the various seasons and hydrological conditions.
- Review of historic information such as aerial photography.
- Professional judgment may be used in conjunction with the total score and supporting information in making the final determination.

The total score can be affected by seasonal or hydrological conditions as well as man-made impacts such as irrigation diversions or livestock impoundments associated with activities in the watershed. For example, a sample reach may score lower in drought conditions due to the lack of biological and/or certain hydrological indicators. However, a reach may score higher on certain indicators such as drift lines and alluvial deposits if directly below a stormwater outfall. The final hydrological determination should take these factors into account.

The *Hydrology Protocol* is considered to be an evolving, living document. Current thresholds are based on data collected by SWQB during the 2008 and 2009 field seasons from 57 stream reaches throughout the state of New Mexico. An analysis of these data was performed to determine which indicators clearly differentiated the three types of streams and to identify threshold values for scoring. In the event that new data indicate the threshold values used in this protocol are not appropriate and/or if new standards are adopted, SWQB will review the protocol, the related threshold values and differentiating scores. Revisions to the protocol will be proposed to the WQCC as needed in accordance with the process for updating the Water Quality Management Plan/Continuing Planning Process.

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