PUBLIC COMMENT DRAFT

HYDROLOGY PROTOCOL

FOR THE

DETERMINATION OF EPHEMERAL, INTERMITTENT, AND PERENNIAL WATERS

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SUMMARY

This protocol provides a tool for distinguishing among ephemeral, intermittent and perennial streams and rivers in New Mexico. The ability to make such determinations is often key to assuring that the appropriate water quality standards are applied to a water body. New Mexico's water quality standards (*Standards for Interstate and Intrastate Waters*, 20.6.4. NMAC) set distinct protections for unclassified ephemeral, intermittent and perennial waters and also identify many classified waters by the nature of their hydrology.

The protocol relies on hydrological, geomorphic and biological indicators of the persistence of water. Field indicators of these characteristics are ranked using a weighted, four-tiered scoring system. Section 1 provides details on the field method and rating form. Section 2 explains how to interpret the overall score and describes other information that may be needed to make a final hydrology determination. For information on the development process for this protocol refer to **Appendix A**.

The protocol at this time applies only to streams and rivers. Waters determined to be intermittent or perennial prior to the effective date of the protocol will not be reevaluated unless there is a specific need to do so.

Introduction

A stream can be described as flowing surface water in a channel resulting from (NCDWQ 2005):

- *Stormflow* – increased 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
- *Base flow* – low flow resulting from sustained discharge of ground water into the stream between rainfall events
- A combination of both stormflow and base flow
- Contributions of discharge from upstream tributaries as stormflow or base flow
- Contributions of discharge from point source dischargers

Streams are drainage features that may 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 hydrologic, biological, and geomorphic (physical) processes. Attributes of these three processes are used in this protocol to produce a numeric score. The score is then used to characterize the stream reach as “ephemeral,” “intermittent,” or “perennial.”

Definitions

The draft Hydrology Protocol is based on the definitions of “ephemeral,” “intermittent” and “perennial” recommended in 20.6.4.7 NMAC of the New Mexico Environment Department’s Revised Triennial Review Petition of the water quality standards dated July 6, 2009. The proposed definitions are as follows:

> *Ephemeral* 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* 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* means the water body contains water throughout the year except during periods of drought.

If an otherwise **perennial** water exhibits intermittency or interruptions due to hydrologic modifications, it is considered perennial. Natural interruptions in ephemeral, intermittent, or perennial waters will be evaluated on a site-by-site basis. If an otherwise **intermittent** water exhibits perennial indicators due to anticipated and/or frequent discharges, then the water may be considered perennial as appropriate based on the site evaluation. If an otherwise **ephemeral** water exhibits intermittent or perennial indicators due to anticipated and/or frequent discharges, then the water may be considered intermittent or perennial as appropriate based on the site evaluation.

SECTION 1 – Stream Determination and Rating Form

User/Evaluator Experience
In order to distinguish ephemeral streams from non-ephemeral ones or intermittent streams from perennial ones using the information presented in this protocol, the evaluator should have experience making geomorphic, hydrological, and biological observations for New Mexico streams.

Assessment Unit Identification & Field Map Generation
Assessment units (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). Stream or river AUs in New Mexico are typically no more than 25 miles in length, unless there are no tributaries or land use changes to consider along the reach (NMED/SWQB 2008).

Before a determination of hydrology can be made for a stream or river reach that currently does not fall under a classified segment as described in 20.6.4.101 through 20.6.4.899 NMAC, the appropriate AU must be identified. If this protocol is being used for a classified stream or river then the AU in question should be reevaluated to determine if it represents relatively homogeneous waters.

Drought Conditions
Spatial and temporal variations in stream attributes occur within and among stream systems. Perhaps the predominant source of variation results from changes in the persistence and volume of flow and the temporal variation of flow. These changes can be related to seasonal precipitation and evapotranspiration patterns as well as influenced by recent weather and interannual climate variability.

Local drought information 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 -1.0 (NDMC 1995). The 12-month SPI will be used to determine drought conditions and noted on the *Stream Determination Field Sheet* (**Appendix B**). SPIs of a 12-month time scale may be tied to streamflows, reservoir levels, and even groundwater levels.

The SPI drought index was chosen for use in this protocol because it can be computed for different time scales, can provide early warning of drought, and can help assess drought severity. The SPI calculation for any location is based on 10 climate regions of New Mexico and long-term precipitation records (both rainfall and snowpack), and has available archived information dating back to 1996.

Recent Rainfall Activity

Recent (generally considered to be within 48 hours) rainfall can also influence scoring; therefore it is *strongly* recommended that field evaluations be conducted at least 48 hours after the last known major rainfall. Field observations regarding the presence or absence of recent high flows should be made and documented on the *Stream Determination Field Sheet* (**Appendix B**) to supplement any available local rain gage data and to determine if field observations were made at least 48 hours following a precipitation event. The Level 1 Field Evaluation should occur between **late May and mid July** **OR** **mid September and early November** (i.e., during the "dry" seasons – after snowmelt runoff and avoiding monsoonal rain) to reduce this source of variability. Please note that the protocol and scoring mechanism have been designed with redundancy (i.e. multiple indicators) to allow for satisfactory ratings even 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.

Scoring

The *Stream Determination Field Sheet* is used to record the score for each attribute and determine the total numeric score for the stream under investigation. The sheet specifically requests information regarding Date, Project, Evaluator, Site, Assessment Unit, 12-month SPI Value, and Latitude/Longitude. However, any other pertinent observations will also be recorded on this sheet, such as indications of recent rain events. These should include the amount and date of the last recent rain and evidence of stream modifications. The *Stream Determination Field Sheet* is an official record, so all pertinent observations will be recorded on it.

A four–tiered, weighted scale used for evaluating and scoring each attribute addresses the variability of stream channels. The scores, "Poor", "Weak", "Moderate", and "Strong" are applied to sets of geomorphic, hydrologic and biological attributes. The score given to an attribute reflects the evaluator's judgment of the average degree of development of the attribute along a representative reach of the stream that is at least 40 times the average stream width. These categories are intended to allow the evaluator flexibility in assessing variable features or attributes. In addition, the small increments in scoring between gradations will help reduce the range in scores between different evaluators. The score ranges were developed in order to better assess the often gradual and variable transitions of streams from ephemeral to non-ephemeral.

A "yes" / "no" format was determined to be inadequate to properly encompass and assess the natural variability encountered when making stream determinations in the field. "Moderate" scores are intended as an approximate qualitative midpoint between the two extremes of "Poor" and "Strong." 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 stream under review, its watershed, and physiographic region.

Table 1. Guide to scoring categories

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

LEVEL 1 EVALUATION:
Data Collection for the Hydrologic Determination of NM Streams and Rivers

Level 1 Office Procedures

The following information should be reviewed prior to conducting a Level 1 Field Evaluation. Gather as much information as you can prior to field work. Unfortunately, not all information listed here will be available for every AU.

Historic or recent flow data from gauges such as those managed by the USGS or Los Alamos National Laboratory (LANL) should be used to make hydrological determinations. Gauge 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*.

The following coverages and resources reside on the SWQB GIS station and will help identify (and name) the appropriate AU for a given investigation and generate field maps showing the project 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 and/or SWQB projects include:

- Google Earth
- NHD_Plus_AUs.mxd (ArcGIS project on Desktop)
- NMED_data.apr (ArcView project on Desktop)
- C://Projects/Hydro_Protocol_Sites.apr (ArcView project)

Useful coverages that can be added to an ArcGIS or ArcView project include:

- SWQB water quality stations
- SWQB assessment units
- NHD_streams
- OSE data (F://GIS folder/data/OSE data/NMOSE_EGIS)
- USGS quadrangle maps
- Aerial photographs
- National Hydrography Dataset, 2004
- Digital Geologic Map of NM
- National Land Cover Dataset, 2000
- BLM Land Status, 2005
- USDA or NRCS soil survey
- Omernik Ecoregions
- NM Roads

The following resources will help determine drought conditions and recent rainfall activity. Unfortunately, not all information listed here will be available for every AU:

- Historic or recent flow data (known sources include SWQB, USGS, or localized sources such as Los Alamos National Laboratory for waters on the Pajarito Plateau)
- Standardized Precipitation Index: http://www.drought.unl.edu/monitor/currspi.htm
- Rain gauge stations within the County
- Airport/regional climate data
- The National Weather Service:
    a. http://www.weather.gov/climate/index.php?wfo=abq
    b. http://www.weather.gov/climate/xmacis.php?wfo=abq
    c. http://water.weather.gov/

Refer to *Assessment Unit Identification and Field Map Generation*, *Drought Conditions*, and *Recent Rainfall Activity* on pages 5-6 for more information.

Level 1 Field Procedures

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

Reach Selection

This protocol describes a method for assessing geomorphic, hydrologic, and biologic 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 reach on which to conduct an assessment can influence the resulting conclusion about flow duration.

Before selecting a location for the survey, note the character of the stream while driving to the site to ensure that the reach is representative of the AU being characterized. A representative reach for stream determinations is typically 40 times the average stream width or 150 meters, whichever is larger. Stream determinations must not be made at one point without first walking up and down the channel for at least 150 meters. Ideally, this visual examination would be from the stream origin to the downstream confluence with a larger stream, but this is usually not feasible nor practical.

This initial examination allows the evaluator to examine and 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 being evaluated. 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 stream segment in question is generally uniform (e.g. "representative") or should be assessed as two or more distinct reaches.

Photodocumentation

It is important to explain the rationale behind any conclusions reached using this protocol and sometimes photos are just the medium to do that. ***A picture is worth a thousand words*** is a saying that comes from an old Chinese proverb "a picture's meaning can express ten thousand words." It refers to the idea that complex stories can be described with just a single still image, or that an image may be more influential than a substantial amount of text (Wikipedia 2009). Therefore, it is essential to take several photos of the reach condition and any disturbances or modifications that are relevant to making a final stream determination.

The assessor should include a detailed description of each photo on the *Stream Determination Field Sheet* and attach the photos to the *Field Sheet* to officially document the reach condition at the time of the evaluation and to support any conclusions that were reached using this protocol.

Level 1 Field Equipment and Supplies

Copy of *Hydrology Protocol* and associated field forms
Site maps and aerial photographs (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 (preferred?)
Clinometer
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)

Level 1 Scoring

Determination of stream type is accomplished by evaluating 12-14 different attributes of the stream and assigning a numeric score to each attribute following the four–tiered, weighted scale described on page 7. Total scores reflect the persistence of water with higher scores indicating intermittent and perennial streams. Please see Section 2 – Guidance for the Determination of Streams and Rivers in NM for more details.

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. Local weather data and drought information should be reviewed before evaluating flow conditions. Perennial streams will have water in their channels year-round in the absence of drought conditions. Drought conditions are defined as any time the Standard Precipitation Index (SPI) is less than -1.0 (NDMC 1995). The 12-month SPI should be determined and noted on the field survey sheet.

Evidence of recent high flows should be noted on the *Stream Determination Field Sheet* (**Appendix B**). 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 event, the stream is either perennial or intermittent. However, intermittent streams do not always have water in them. A good rule of thumb for differentiating ephemeral streams from intermittent ones is if they have water in them during dry (drought) conditions or during the growing season. Look for water in pool areas in the streambed. The presence or type of plants as well as saturated or moist sediment underneath rocks located within the stream channel are also good indications of the presence of water during dry (drought) conditions or during the growing season.

If the site is visited during the dry season (defined in NM as late May to mid July and mid September to early November during an average year) 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 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 bank.

Strong – Flow is evident throughout the 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 (i.e. riparian vegetation growing along channel, saturated or moist sediment under rocks, etc)

Poor – Dry channel. No evidence of base flows was found.

1.2. Fish (qualitative observations)

In most cases, fish are indicators of perennial streams, 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 along the stream. Check several areas along the stream sampling reach, especially underneath undercut banks.

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

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 streams 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 reach.
Moderate - Found with little difficulty but not consistently throughout the reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Poor - Benthic macroinvertebrates are not present.

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 structure within the stream 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 reach.
Moderate - Found with little difficulty but not consistently throughout the reach.
Weak - Takes 10 or more minutes of extensive searching to find.
Poor - Filamentous algae and/or periphyton are not present.

1.5. Differences in Vegetation

As a rule, only perennial and intermittent streams can support riparian areas that serve the entire suite of riparian ecological functions. Ephemeral streams generally do not possess the hydrologic conditions that allow true riparian vegetation to grow. Although water flows down ephemeral streams 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 streams 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 Stream Determination Field Sheet******

Strong – Dramatic compositional differences in vegetation are present between the stream banks and the adjacent uplands. A distinct riparian vegetation corridor exists along the entire reach – riparian, aquatic, or wetland species dominate the length of the reach.

Moderate – A distinct riparian vegetation corridor exists along part of the reach. Riparian vegetation is interspersed with upland vegetation along the length of the reach.

Weak – Vegetation growing along the reach may occur in greater densities or grow more vigorously than vegetation in the adjacent uplands, but there are no dramatic compositional differences between the two.

Poor – No compositional or density differences in vegetation are present between the streambanks and 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 of the stream and plants growing on any part of the bank of the stream 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).

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 stream being evaluated has a score ≤ 2 up to this point, attainment of Clean Water Act Section 101(a)(2) uses is not feasible. The stream is determined to be ephemeral. If the stream being evaluated has a score ≥ 18 at this point, the stream is determined to be perennial. You can STOP the evaluation. However, if the stream has a score between 2 and 18 you should continue the Level 1 Evaluation.***

1.7. Sinuosity

Sinuosity is a measure of a stream's "crookedness." Sinuosity is the result of the stream naturally dissipating its flow forces. Intermittent streams 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, 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). The higher the ratio (SL/VL), the more sinuous the stream.

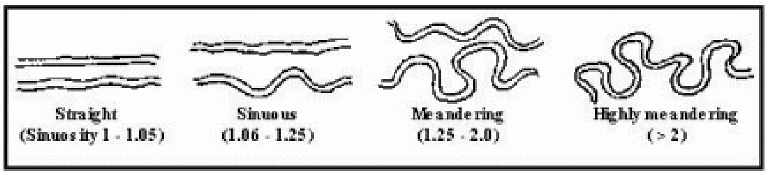


Figure 1. Examples of Stream Sinuosity (NCDWQ 2005)

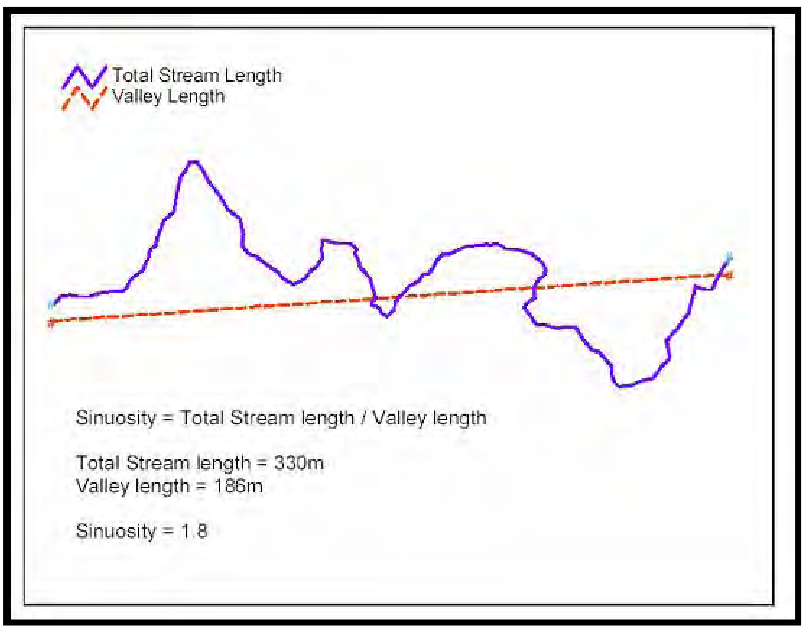


Figure 2. Stream Sinuosity (NCDWQ 2005)

******Note method used to determine sinuosity on the Stream Determination Field Sheet******

Strong - Ratio > 1.4. Stream has numerous, closely-spaced bends, few straight sections.
Moderate - Ratio < 1.4. Stream has good sinuosity with some straight sections.
Weak - Ratio < 1.2. Stream has very few bends and mostly straight sections.
Poor - Ratio = 1.0. Stream is completely straight with no bends.

1.8. Entrenchment Ratio

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 channels is their enormous variability in form, they tend to have low entrenchment ratios relative to intermittent and perennial channels (Knight et al. 1999).

Entrenchment is qualitatively defined as the vertical containment of a river and the degree to which it is incised in the valley floor (Kellerhals et al. 1972). When determining entrenchment, it is important to distinguish whether the flat adjacent to the channel is a frequent floodplain, a terrace (abandoned floodplain), or is well outside of the flood-prone area. The entrenchment ratio is the ratio of the width of the flood-prone area to the surface width of the bankfull channel (Rosgen 1994)*. 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 1). 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 stream 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.

<u>Entrenchment Ratio Field Protocol:</u>

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

1. Once a representative reach 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 the *Level 1 Field Measurements* sheet.
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 Measurements* sheet.

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 Measurements* sheet.
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 locations on each bank. Measure the distance between the two "FPA" locations. Record the measured FPA width on *Level 1 Field Measurements* sheet.
6. Measure the distance between the two Bankfull Stage locations. Record the measured Bankfull Width on *Level 1 Field Measurements* sheet.
7. Divide the FPA Width by the Bankfull Width to calculate the Entrenchment Ratio. Record the calculated Entrenchment Ratio on *Level 1 Field Measurements* sheet.

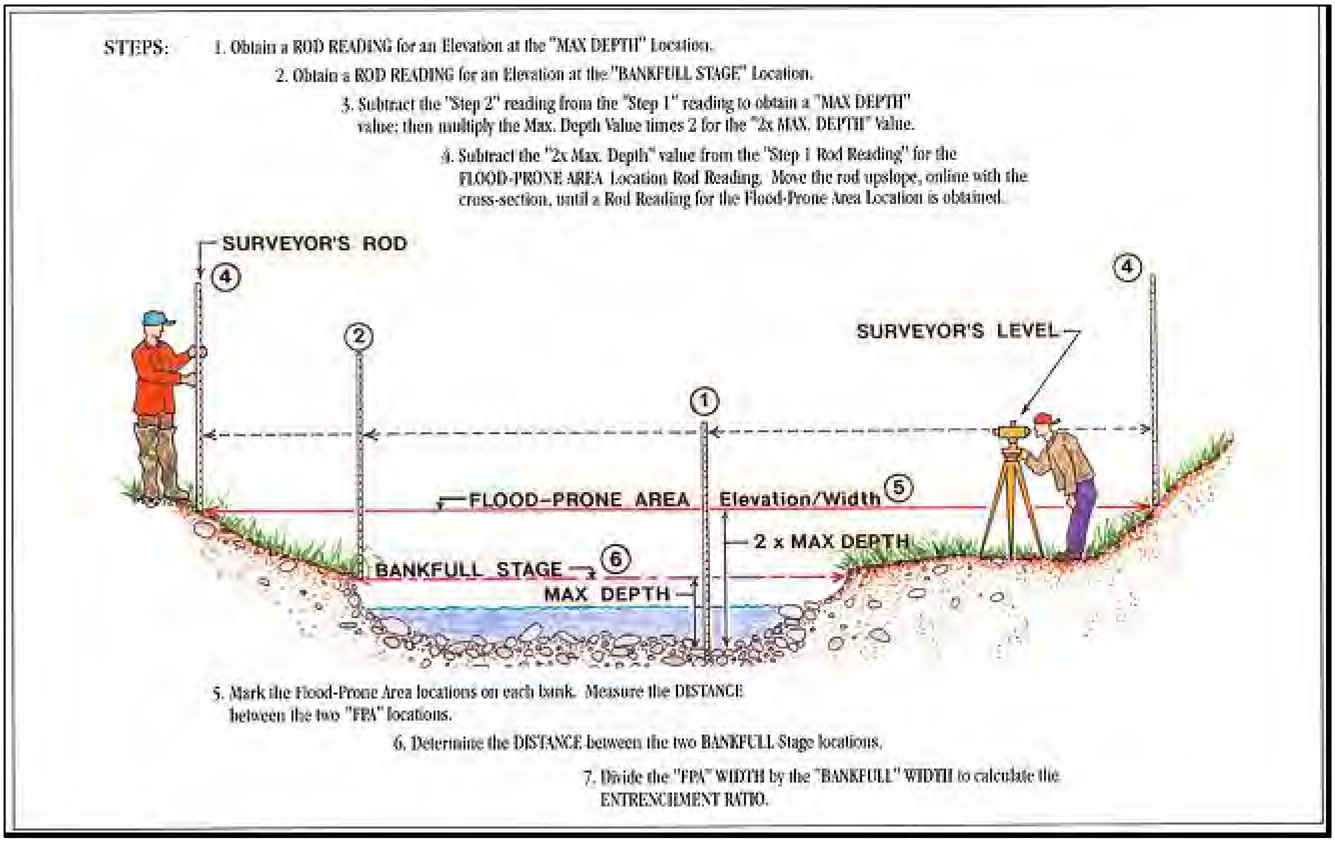


Figure 3. Determining a Flood-Prone Area elevation/width for calculation of Entrenchment Ratio (Rosgen 1996)

******Alternative methods to determine ER should be described and recorded on the Stream Determination Field Sheet******

Strong - Ratio > 2.5*. Stream is slightly entrenched.
Moderate - Ratio between 1.2 and 2.5. Stream is moderately entrenched.
Weak - Ratio < 1.2. Stream is entrenched.

<u>*NOTE</u>: a high entrenchment ratio implies a low entrenchment condition, while a low entrenchment ratio implies an entrenched condition.

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

A repeating sequence of riffle/pool (riffle/run in lower gradient streams, ripple/pool in sand bed streams, or step/pool in higher gradient streams) can be observed readily in perennial streams. Riffle-run (or ripple-run) sequences in low gradient streams 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 stream bed 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 stream 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 reach. There is an obvious transition between riffles and pools.

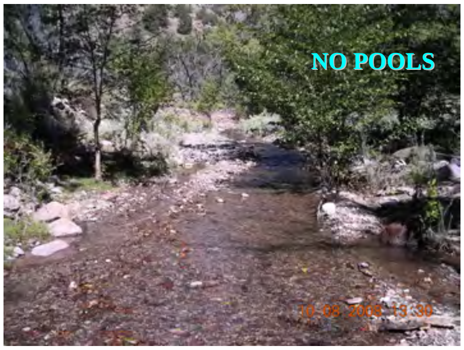
Moderate - Represented by a less frequent number of riffles and pools. Distinguishing the transition between riffles and pools is difficult.

Weak - Streams show some flow but mostly have areas of pools <u>or</u> of riffles.

Poor - There is no sequence exhibited, or there is no flow in the channel.

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 stream being evaluated has a score ≤ 5 at this point, attainment of Clean Water Act Section 101(a)(2) uses is not feasible. The stream is determined to be ephemeral. If the stream being evaluated has a score ≥ 21 at this point, the stream is determined to be perennial. You can STOP the evaluation. However, if the stream 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 stream 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 stream. 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 but which have little or no coarse bottom materials indicative of upstream erosion and downstream transport. The bottom substrate of non-ephemeral streams 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 stream 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.

Pebble Count Field Protocol (OPTIONAL – only necessary if field investigators cannot determine between the categories described below)

If more quantified observations are needed, then the evaluator(s) should start by selecting a representative reach to conduct the pebble count. Divide the representative reach into 5 equidistant transects, collecting particles within the bankfull channel. Start either at the top or bottom of the reach at a random point near bankfull. Avert gaze, pick up the first particle touched by the tip of the index finger at the toe of the left (or right) foot and measure the intermediate axis with a metric ruler. If particles are too small to measure, classify (silt/clay, very fine sand, etc) using a sand-gauge card. Immovable embedded substrate or substrate to large to lift should be measured in place (measure the smaller of the two exposed axes). Call out the measurement to the note taker who will tally it to the proper size classification on the *Hydrology Protocol Pebble Count Tally Sheet* and repeat the measurement back to you for confirmation. The note taker may also keep count of the particles measured in each transect and the riffle by using a mechanical tally counter. After completing the first measurement, step along the transect toward the opposite bank adjusting the length of the stride into equal distances to ensure 10 measurement points along the transect. Each measurement should be made as previously described; picking up and measuring the first particle touched by the index finger at the tip of the foot without gazing down to look. After inventorying 10 particles along the transect line, the evaluator should move to the next transect and repeat the process until 5 transects have been competed and the 50 particles (or more) have been measured. 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 along same transect used for 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 stream channel or even in dry streambeds.

If the stream is small (i.e. less than 1 meter width) 5 particles from each of 10 transects is acceptable. Likewise, if a transect is too short to fit ten measurement points, another representative transect may be sampled as well. The objective is to measure at least 50 pebbles (10 in 5 transects or 5 in 10 transects- depending on stream size) for accurate distributional representation.

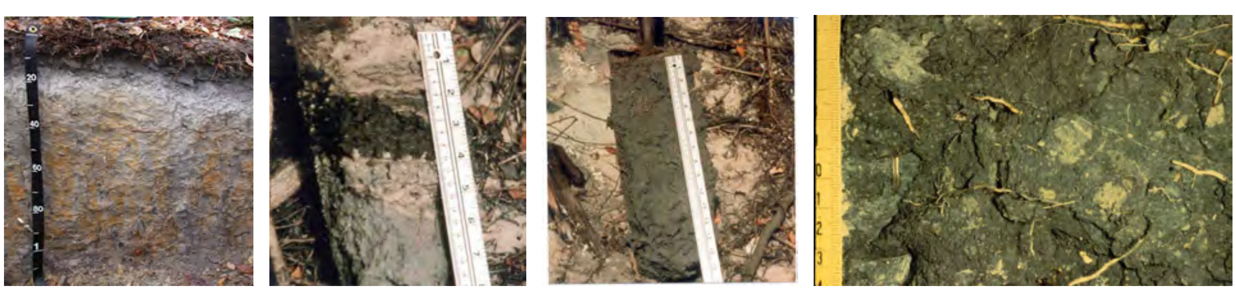
Strong - Particle sizes in the channel are noticeably different from particle sizes in areas close to but not in the channel. There is a clear distribution of various sized substrates in the stream channel with finer particles accumulating in the pools, and larger particles accumulating in the riffles/runs.

Moderate - Particle sizes in the channel are moderately similar to particle sizes in areas close to but not in the channel. Various sized substrates are present in the stream 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 in areas close to but not in the channel. Substrate sorting is not readily observed in the stream 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 http://soils.usda.gov/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: http://www.usace.army.mil/CECW/Pages/reg_supp.aspx



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 study reach.
Absent – Hydric soils are not found within the study 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 stream 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 stream, 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 stream channel, and can confound this indicator. Note these activities on the data sheet if these confounding factors are present.

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

Refer to Section 2, page 36, 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. If the indicator is present record the score on the *Stream Determination Field Sheet* (**Appendix B**) 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 stream bank. Springs: Look for "mushy" or very wet, black decomposing leaf litter nearby in small depressions or stream channels. 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 abundance of these features observed within the reach.

1.14. Iron Oxidizing Bacteria/Fungi

These features are often (although not exclusively) associated with groundwater. Iron oxidizing bacteria/fungi in streams derives 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 discolors the stream 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.

Oily sheen on water's surface due to iron-oxidizing bacteria

(photos found at: http://www.arlingtonva.us/departments/EnvironmentalServices/epo/EnvironmentalServicesEpoDr.aspx)

****Refer to Section 2, page 36, for guidance on overall Level 1 score interpretation****

LEVEL 2 EVALUATION: Borderline Determinations

If after conducting a Level 1 Evaluation, a stream 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.

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 the *Assessment Unit Identification and Field Map Generation*, *Drought Conditions*, and *Recent Rainfall Activity* sections on pages 5-6 and the *Level 1 Office Procedures* on page 8 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:

Observation of flow: Observation of flow under certain seasonal or hydrologic conditions can directly support classifying a stream reach as perennial. Stream reaches with flow during the dry season, growing 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 streams may only contain isolated pools of water or be dry during periods of drought.

- **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 deployment of a thermograph or electrical resistance sensor?** (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 stream reach is perennial. If a stream or river 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 (http://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 may be found at P:\SWQB PUBLIC\Gary S Public

Other information to be considered:

- Information provided by a long-term resident and/or local professional who has observed the stream during various seasons and hydrologic 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.

Level 2 Field Procedures

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

Reach Selection

This protocol describes a method for assessing geomorphic, hydrologic, and biologic 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 reach on which to conduct an assessment can influence the resulting conclusion about flow duration.

Before selecting a location for the survey, note the character of the stream while driving to the site to ensure that the reach is representative of the AU being characterized. A representative reach for stream determinations is typically 40 times the average stream width or 150 meters, whichever is larger. Stream determinations must not be made at one point without first walking up and down the channel for at least 150 meters. Ideally, this visual examination would be from the stream origin to the downstream confluence with a larger stream, but this is usually not feasible nor practical.

This initial examination allows the evaluator to examine and 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 being evaluated. 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 stream segment in question is generally uniform (e.g. “representative”) or should be assessed as two or more distinct reaches.

Photodocumentation

It is important to explain the rationale behind any conclusions reached using this protocol and sometimes photos are just the medium to do that. ***A picture is worth a thousand words*** is a saying that comes from an old Chinese proverb “a picture's meaning can express ten thousand words.” It refers to the idea that complex stories can be described with just a single still image, or that an image may be more influential than a substantial amount of text (Wikipedia 2009). Therefore, it is essential to take several photos of the reach condition and any disturbances or modifications that are relevant to making a final stream determination.

The assessor should include a detailed description of each photo on the *Stream Determination Field Sheet* and attach the photos to the *Field Sheet* to officially document the reach condition at the time of the evaluation and to support any conclusions that were reached using this protocol.

Level 2 Field Equipment and Supplies

Copy of *Hydrology Protocol* and associated field forms
Thermograph deployment/download form
Fish collection/voucher specimen sheet
Site maps and aerial photographs (1:250 scale if possible)
Global Positioning System (GPS) – used to determine latitude and longitude
Camera – used to photograph and document site features
Clipboard/pencils/sharpies
Measuring tape
Survey flags for transect locations (11/site… reusable)
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)
2 buckets (reach wide & targeted riffle)
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

Level 2 Scoring

Determination of stream type is accomplished by evaluating 7 different attributes of the stream and assigning a numeric score to each attribute. Scores should reflect the persistence of water with higher scores indicating perennial streams.

LEVEL 2 INDICATORS

2.1. Water in Channel (OPTIONAL)

Observation of flow under certain seasonal or hydrologic conditions can directly support classifying a stream reach as perennial. Stream reaches with flow during the dry season, growing 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.

Temperature sensors (or electrical resistance sensors) 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 diurnal 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 stream flow where little dampening has occurred, a flow signal is easily identifiable.

Thermograph Deployment Field Protocol:

When an SWQB staff member requires the use of one or more thermographs, a request is made to the thermograph manager. The manager sets the parameters (e.g., recording interval, triggered or delayed start, etc.) of the thermograph according to the staff member's specifications.

Upon thermograph deployment, field technicians fill out the *Thermograph Field Sheet* as completely as possible, including GPS latitude/longitude (in decimal degree format). Copies of the *Thermograph Field Sheet* are provided to the manager. After the thermograph is retrieved, it is given to the manager who downloads the data.

Two thermographs should be placed in each Assessment Unit (AU), one "water" and one "air" thermograph, at locations representative of ambient stream and atmospheric conditions. The water thermograph should not be placed in shallow riffles or in deep pools. The thermograph should be deployed in a transition between a riffle/run and a pool, and if possible, it should be placed at the toe of a pool as it becomes shallower, prior to entering a run or riffle. The thermograph should be placed such that, under expected flow conditions, it will be continually submerged. The air thermograph should not be placed in direct sunlight. The thermograph should be deployed in a shaded area, attached to the underside of a tree or bush to prevent the influence of direct solar radiation. Actual situations encountered during thermograph deployment will vary.

The most common technique for thermograph deployment is to drive a length of rebar into the stream bed using a small sledgehammer. The thermograph is then secured to the rebar using at least two plastic wire ties. Steel T-posts may be used for soft sediment or deeper streams in the same manner. Air thermographs are secured to upland vegetation using at least two plastic wire ties. Using a GPS unit, record each thermograph's lat/long location on the deployment sheet. Take a digital photograph showing the position, typically with a field technician pointing to the instrument's location. For the water thermograph, clearly indicate direction of flow and left/right bank. Flag the locales with surveyor's tape to facilitate location upon return. Draw a clear map so that staff members not present at deployment will be able to easily locate the thermographs for retrieval.

Because thermographs are subject to loss for a variety of reasons beyond staff control (e.g. vandalism, theft, high flows), it is advisable to download data periodically (typically once a month) during the sampling season, using a lap top computer in the field. A file name, consisting of the station name and thermograph serial number, is assigned to each data set upon the initial interim download. Upon return from the field, these data are copied to the manager's computer (and, optionally, to the survey lead's computer). The thermograph is left running during interim download so that a full data set is copied at each download, obviating the necessity to combine files. The interim download date and time are recorded on the *Thermograph Field Sheet*.

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

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

Weak – The thermograph of the water sensor differs somewhat from the thermograph of the air sensor. A flow signal is identifiable during certain days or weeks; however, there are long periods of time when the water sensor thermograph has a diurnal temperature signal that is comparable to the air sensor indicating periods of drying.

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

2.2. Hyporheic Zone/Groundwater Table

<u>Hyporheic zone</u>: 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 river or stream 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 much groundwater discharge to the stream, 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 stream 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 reach.
Moderate – Some base flow is present. Hyporheic zone and/or groundwater table is present, but not abundant throughout 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 study reach.
Absent – Bivalves are not found within the study 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 study reach.
Absent – Amphibians are not found within the study reach.

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* that may be a useful supplement to this protocol. The NMED/SWQB in cooperation with NM Department of Game and Fish (NMDGF) continues to compile a list of organisms of intermittent ecosystems (available by contacting Brian Lang (NMDGF) or James Hogan

(NMED/SWQB)). In addition, SWQB scientists have been looking for the presence of long-lived aquatic species as reliable determinants for perennial channels, North Carolina State University is continuing to work on a list of specific genus that exhibit aquatic larval stages requiring a year before maturity, and West Virginia's Department of Environmental Protection maintains a list of macroinvertebrate species that have an extended aquatic life stage. Further information on life histories of specific macroinvertbrates found through the application of this protocol can be researched, if necessary.

Benthic Macroinvertebrate Field Protocol:

This protocol uses a 30 cm wide D-frame kick net with a mesh size of 500 µm and a sample area of 0.09 m^2 (1 ft^2). Two types of samples are collected: a "reach wide" and a "targeted riffle" sample. The reach wide sample is comprised of one individual sample from each equidistantly spaced transect throughout the reach that are composited into one. The targeted riffle sample is comprised of 8 individual samples from riffle habitat in the reach that are composited into one.

Because the reach-wide and targeted riffle samples are collected in the order they are encountered during a single pass through the reach, it is very important to rinse the kick net thoroughly between samples to avoid carryover and possible cross-contamination of the reach wide sample and the targeted riffle sample.

REACH WIDE SAMPLE

SWQB assesses habitat over stream reach lengths that are approximately 40 times their average wetted width at base flow, but not less than 150 meters long. These procedures are most efficient when applied in low flow conditions, while terrestrial vegetation is still active. Use a surveyor's rod or tape measure to determine the wetted width of the channel at five places considered to be of "typical" width. Average the five readings together and round to the nearest 1 meter. If the average width is less than 4 meters, use 150 meters as a minimum sample reach length.

Starting at the midpoint of the reach, measure a distance of 20 channel widths down one side of the stream using a tape measure. Enter the channel to make measurements only when necessary to avoid disturbing the stream channel prior to sampling activities. This endpoint is the downstream end of the reach, and is flagged as transect "A". For transect A, roll the dice to determine if it is a left (L), center (C), or right (R) sampling point for collecting benthic macroinvertebrate samples. A roll of 1 or 2 indicates L, 3 or 4 indicates C, and 5 or 6 indicates R (or use a digital wristwatch and glance at the last digit (1-3=L, 4-6=C, 7-9=R). Mark L, C, or R on the transect flagging. Using the tape measure, measure 1/10 of the total reach length upstream from the start point (transect A). Flag this spot as the next transect (transect B). Proceed upstream with the tape measure and flag the positions of 9 additional transects (labeled "C" through "K" as you move upstream) at intervals equal to 1/10 of the reach length. Assign sampling spots to each transect in order as L, C, R after the first random selection. For example, if the sampling spot assigned to transect "B" was C, transect "C" is assigned R, transect "D" is L, transect "E" is C, etc. Generally, the latitude and longitude of the site is taken at the middle of the surveyed reach (transect F).

Collect a kick net sample from each of eleven transects (“A” through “K”) after randomly establishing the sample location at transect A (Left, Center, or Right) using the method described above. Figure 4 illustrates the sampling design for the reach wide sample. If a sampling point is located in water that is too deep or otherwise unsafe to wade, select an alternate sampling point on the transect at random (Figure 4).

At each sampling point, determine if the habitat is a “riffle/run” or a “pool/glide”. If there is not sufficient current to extend the net, the area is operationally defined as a pool/glide habitat and the sample is collected using the pool/glide procedure. As you proceed upstream from transect to transect, combine all kick net samples into a bucket or similar container labeled “Reach Wide”, regardless of whether they were collected using the “riffle/run” or “pool/glide” procedure.

If it is impossible to sample at the sampling point with the modified kick net following either procedure, spend about 30 seconds hand picking a sample from about 0.09 m^2 (1 ft^2) of substrate at the sampling point. Place the contents of this hand-picked sample into the “Reach Wide” sampling container. For vegetation-choked sampling points, sweep the net through the vegetation for 30 seconds. If sample cannot be collected at the correct location, sample at the closest point possible and note on *Sample Collection Form*. If no sample can be collected for a transect, make a note on *Sample Collection Form*.

<u>Riffle/Run Procedure</u>

Beginning with Transect “A”, locate the assigned sampling point (Left, Center, or Right as you face downstream) as 25%, 50%, and 75% of the wetted width, respectively. With the net opening facing upstream, position the net quickly and securely on the stream bottom to eliminate gaps under the frame. Avoid large rocks that prevent the sampler from seating properly on the stream bottom. Holding the net in position on the substrate, visually define a rectangular quadrat that is one net width wide and one net width long upstream of the net opening. The area within this quadrat is 0.09 m^2 (1 ft^2). Check the quadrat for heavy organisms, such as mussels and snails. Remove these organisms from the substrate by hand and place them into the net. Pick up any loose rocks or other larger substrate particles in the quadrat. Use your hands or a small scrub brush to dislodge organisms so that they are washed into the net. Scrub all rocks that are golf ball-sized or larger and which are over halfway into the quadrat. Large rocks that are less than halfway into the sampling area are pushed aside. After scrubbing, place the substrate particles outside of the quadrat. Keep holding the sampler securely in position. Start at the upstream end of the quadrat, vigorously kick the remaining finer substrate within the quadrat for 30 seconds. Pull the net up out of the water. Immerse the net in the stream several times to remove fine sediments and to concentrate organisms at the end of the net.

For the reach wide sample, invert the net into a plastic bucket marked "reach wide" and transfer the sample. Inspect the net for any residual organisms clinging to the net and deposit them into the "reach wide" bucket. Use watchmakers’ forceps if necessary to remove organisms from the net. Carefully inspect any large objects (such as rocks, sticks, and leaves) in the bucket and wash any organisms found off of the objects and into the bucket before discarding the object. Remove as much detritus as possible without losing any organisms. Thoroughly rinse the net before proceeding to the next sampling location. Proceed upstream to the next transect (including Transect K, the upstream end of the sampling reach) and repeat. Combine all kick net samples from riffle/run and pool/glide habitats into the "reach wide" bucket.

Pool/Glide Procedure

Beginning with Transect "A", locate the assigned sampling point (Left, Center, or Right as you face downstream) as 25%, 50%, and 75% of the wetted width, respectively. Visually define a rectangular quadrat that is one net width wide and one net width long at the sampling point. The area within this quadrat is 0.09 m^2 (1 ft^2). Inspect the stream bottom within the quadrat for any heavy organisms, such as mussels and snails. Remove these organisms by hand and place them into the net or into the "reach wide" bucket. Pick up any loose rocks or other larger substrate particles within the quadrat and hold them in front of the net. Use your hands (or a scrub brush) to rub any clinging organisms off of rocks or other pieces of larger substrate (especially those covered with algae or other debris) into the net. After scrubbing, place the larger substrate particles outside of the quadrat. Vigorously kick the remaining finer substrate within the quadrat with your feet while dragging the net repeatedly through the disturbed area just above the bottom. Keep moving the net all the time so that the organisms trapped in the net will not escape. Continue kicking the substrate and moving the net for 30 seconds. NOTE: If there is too little water to use the kick net, stir up the substrate with your gloved hands and use a sieve with 500 μm mesh size to collect the organisms from the water in the same way the net is used in larger pools. After 30 seconds, remove the net from the water with a quick upstream motion to wash the organisms to the bottom of the net.

For the reach wide sample, invert the net into a plastic bucket marked "reach wide" and transfer the sample. Inspect the net for any residual organisms clinging to the net and deposit them into the "reach wide" bucket. Use watchmakers' forceps if necessary to remove organisms from the net. Carefully inspect any large objects (such as rocks, sticks, and leaves) in the bucket and wash any organisms found off of the objects and into the bucket before discarding the object. Remove as much detritus as possible without losing any organisms. Thoroughly rinse the net before proceeding to the next sampling location. Proceed upstream to the next transect (including Transect K, the upstream end of the sampling reach) and repeat. Combine all kick net samples from riffle/run and pool/glide habitats into the "reach wide" bucket.

TARGETED RIFFLE SAMPLE

While laying out the reach and transect flags, survey the stream reach to visually estimate the total number (and area) of riffle macrohabitat units. Riffle habitat area must be greater than 0.09 m^2 (1 ft^2) to be considered a riffle macrohabitat unit for sampling. Figure 5 illustrates the sampling design for the targeted riffle sample. If the reach contains more than one distinct riffle macrohabitat units but less than eight, allocate the eight sampling points among the units so as to spread the effort throughout the reach as much as possible. You may need to collect more than one kick sample from a given riffle unit. If the number of riffle macrohabitat units is greater than eight, skip one or more habitat units at random as you work upstream, again attempting to spread the sampling points throughout the reach. When total available area of riffle habitat is less than

0.74 m^2 (8 ft^2) (i.e., 8 non-overlapping kick net samples cannot be collected), do not collect a targeted riffle sample.

Visually lay out the core area of the unit sampled into 9 equal quadrats (i.e., a 3 × 3 grid). For each macrohabitat type, select a quadrat for sampling at random from the following list of locations (right and left are determined as you look downstream):

Lower right quadrat	Right center quadrat	Upper right quadrat.
Lower center quadrat	Center quadrat	Upper center quadrat.
Lower left quadrat	Left center quadrat	Upper left quadrat

Collect the kick sample in the center of the randomly selected quadrat using the Riffle/Run Procedure described above. Invert the net into a plastic bucket marked "targeted riffle" and transfer the sample into the bucket. Inspect the net for any residual organisms clinging to the net and deposit them into the "targeted riffle" bucket. Use watchmakers' forceps if necessary to remove organisms from the net. Thoroughly rinse the net before proceeding to the next sampling location (either the next riffle unit or a different quadrat location within the same riffle unit). Repeat procedures at subsequent riffle sampling points until 8 kick samples have been collected and placed into the "targeted riffle" bucket (Figure 5).

After collecting kick net samples for both the reach wide and targeted riffle samples, prepare one composite sample from the contents of the "Reach Wide" bucket and one composite sample from the contents of the "Targeted Riffle" bucket using 500-mL or 1-L aliquots. Do not fill the jars more than half full. Divide the sample into as many jars as needed and indicate jar number on the sample label. Fill the jar with 95% ethanol (EtOH) leaving no headspace. Replace the cap on each jar. Slowly tip the jar to a horizontal position and gently rotate the jar to mix the preservative. Do not shake the jar. A completed sample label is required for all sample jars from a single composite sample and is placed inside the sample jar for identification purposes. The sample label should include the Station ID, Stream Name, Collection Date, Type of Sampler (kick net), Habitat Type (reach wide or targeted riffle), Collector(s) Name, Number of Transects, and Jar Number (e.g. 1 of 3). Send the samples to a qualified aquatic biologist/environmental scientist for identification and enumeration.

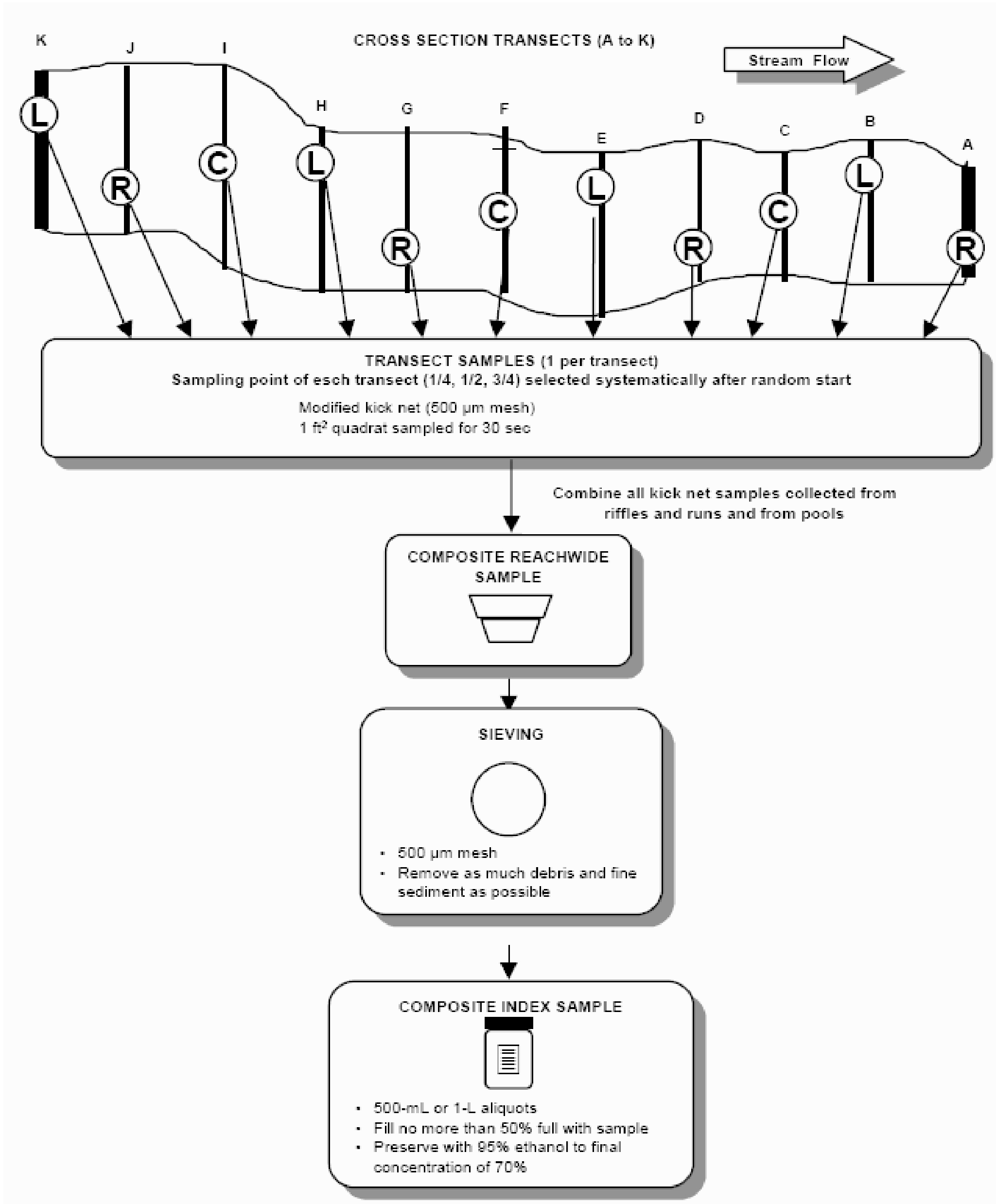


Figure 4. Sampling design for reach wide benthic macroinvertebrate sample locations

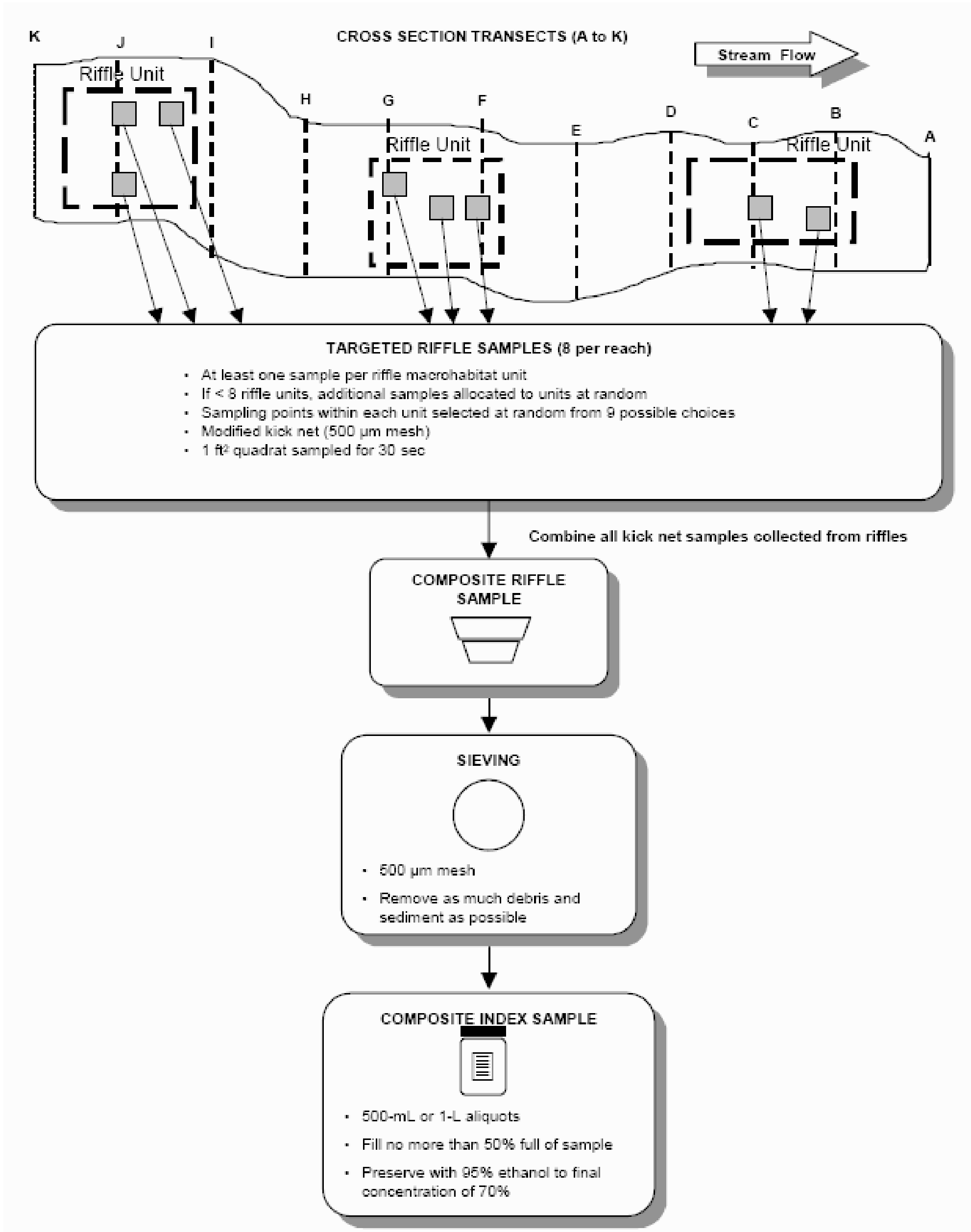


Figure 5. Sampling design for targeted riffle benthic macroinvertebrate sample locations

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 stream features are listed in Tables 2 and 3.

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.

Poor - Benthic macroinvertebrates are not present.

Table 2. Ephemeroptera, Plecoptera, and Trichoptera (EPT) perennial indicator taxa

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

Table 3. Additional indicators of perennial features

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

2.6. Ephemeroptera, Plecoptera, and Tricoptera (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 streams. Studies conducted by North Carolina State University have found that benthic samples collected in intermittent streams frequently display crustaceans (crayfish, isopods, and amphipods) as the dominant order (NCDWQ 2005). Downstream, where the stream has perennial characteristics, EPT taxa were collected. In highly urbanized areas, these indicators may be absent due to the degraded nature of the stream and, therefore, cannot be used to evaluate perennial or intermittent flow conditions. North Carolina State University is continuing to work on a list of specific genus that exhibit aquatic larval stages requiring a year before maturity. West Virginia's Department of Environmental Protection also maintains a list of macroinvertebrate species that have an extended aquatic life stage (NCDWQ 2005). Additional information on life histories of specific macroinvertbrates found through the application of this protocol can be researched if necessary. These lists should be consulted (family or genus level ID) before applying points to the reach score, because 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 study reach.
Absent – EPT taxa are not found within the study reach.

2.7. Fish (quantitative observations)

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. Check several areas along the stream sampling reach, especially underneath undercut banks. In most cases, fish are indicators of perennial streams, 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 prime habitats. Multiple age classes are present.
Moderate - Fish are evident in smaller numbers with one age class dominating. Some prime habitat is not occupied.
Weak - Fish are not readily visible, require 10 or more minutes to locate. Very sparse.
Poor - Fish are not found within the study reach.

SECTION 2 – Guidance for Overall Score Interpretation

The final determination of whether a stream reach is 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 provide enough information to accurately distinguish between ephemeral, intermittent, and perennial systems in most cases. Scores should reflect the persistence of water with higher scores indicating intermittent and perennial streams. However, if a stream is recognized as borderline or substantially affected by man-made activities or if observations are made during drought, then a Level 2 evaluation that relies on more intensive data collection will be needed to make a final determination.

For a Level 1 evaluation, the SWQB recommends 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, thus the stream is at least intermittent. In addition, a Level 1 score greater than 22.0 should be used to distinguish 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 4 summarizes interpretation of Level 1 scoring. In most instances, the use of a Level 1 Evaluation should be sufficient to make a final stream determination. If after conducting Level 1 Evaluation, a stream determination cannot be made because more information is required, then a Level 2 evaluation which uses more intensive data collection can be conducted.

Table 4. Summary of Score Interpretation

Waterbody Type	Level 1 Total Score	Stream 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.

The *Hydrology Protocol* is considered to be an evolving, living document. Current thresholds are based on data collected utilizing the *Hydrology Protocol* 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 (Refer to **Appendix A** for more information). In the event that new data indicate the threshold values used in this protocol are not appropriate and/or if new standards are adopted, the threshold values and differentiating scores will be adjusted accordingly.

For a Level 2 evaluation, higher scores indicate that a channel has more perennial characteristics. While SWQB has not developed thresholds for the determination of waterbody's hydrologic type, the data collection and analysis performed for a Level 2 evaluation can be used to develop a detailed UAA to support the proper standards classification for a given reach. As such, streams and rivers with lower scores may be classified as ephemeral or intermittent; however, additional supporting information, as discussed below, should be used to make the final hydrologic determination.

The total score can be affected by seasonal or hydrologic conditions as well as man-made impacts associated with activities in the watershed. For example, a reach may score less in drought conditions due to the lack of biological and/or certain hydrologic 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 must take these factors into account.

If a stream or river is recognized as borderline, reaches upstream and downstream should be assessed to better evaluate the changes in stream classifications along a channel. Additional supporting information can be used with the total score to make the final determination. This supporting information includes:

<u>Observation of flow</u>: Observation of flow under certain seasonal or hydrologic 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, growing 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.

<u>Key biological indicators</u>: 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 macroinvertebrates and vertebrates species before determining the final stream classification.

<u>Additional supporting information to be considered</u>:

- Information provided by a long-term resident and/or local professional who has observed the stream during the various seasons and hydrologic 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.

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APPENDIX A:

Development of the Hydrology Protocol

Why Develop a Hydrology Protocol?

Perennial, intermittent, and ephemeral, as they pertain to all types of waterbodies, are defined in New Mexico's water quality standards (WQS). Amendments adopted by the Water Quality Control Commission in 2005 created new sections in the WQS that established designated uses and criteria for unclassified waters. Three separate provisions addressed ephemeral waters, intermittent waters, and perennial waters. The new provisions responded to a long-standing EPA concern that all waters, not only specifically identified classified waters, must be protected by WQS in compliance with the Clean Water Act (CWA).

EPA supported the concept of these provisions, but disagreed that the designated aquatic life and recreation uses satisfied the CWA and EPA regulations. CWA section 101(a)(2) requires water quality standards to provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water – functions commonly referred to as "fishable/swimmable" uses. EPA's current water quality standards regulation effectively establishes a rebuttable presumption that, at a minimum, all surface waters (ephemeral, intermittent and perennial) can support "fishable/swimmable" uses until additional supporting documentation can be provided to demonstrate that such uses are not attainable. EPA does not expect New Mexico to adopt uses for ephemeral or intermittent waters that cannot be attained, but in those instances, 40 CFR 131.10(j)(1) requires the State to submit a use attainability analysis (UAA) to support a designated use that does not meet the CWA §101(a)(2) objective.

The *Hydrology Protocol* was developed to provide supporting documentation for the UAA process, especially for identifying attainable uses on ephemeral streams. Under federal regulation, CWA §101(a)(2) uses may be considered infeasible only if one of the factors listed in 40 CFR 131.10(g) applies. The two factors most likely to apply under ephemeral or intermittent conditions are that "natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use… " or that "physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses." The Hydrology Protocol provides a tool for evaluating these factors as they relate to flow and water level.

The Surface Water Quality Bureau (SWQB) developed the Hydrology Protocol in response to EPA's concerns about the 2005 WQS amendments. It is expected to be an important tool in identifying unclassified ephemeral streams. However, because the WQS refer in numerous cases to the hydrology of classified water bodies, the SWQB anticipates using the protocol to distinguish intermittent from perennial streams when necessary, thus reducing the controversy that has at times accompanied such determinations.

How Was the Protocol Developed?

The SWQB initiated development of the Hydrology Protocol in February 2008. The objective was to develop a scientifically sound *and* practical protocol that evaluates the hydrology, biology, and geomorphology of stream features to determine if a stream or river is ephemeral, intermittent, or perennial. After reviewing approaches used in other states, SWQB adapted a stream evaluation methodology developed by the North Carolina Division of Water Quality (NCDWQ 2005*) to conditions in New Mexico. In this approach, field indicators of hydrological, biological, and physical characteristics are ranked using a weighted, four-tiered scoring system. A numerical rating system format was used based on requests from the EPA, the regulated community in New Mexico, and other stakeholders for an objective, practical scoring mechanism for determining the hydrologic status of a stream. As discussed below, a stream reach is determined to be ephemeral, intermittent, or perennial based on the overall score and other supporting information.

Relevant characteristics and scoring thresholds were developed using a preliminary dataset from 25 sites in 2008. Sites with known hydrologic characteristics, either due to the presence of USGS stream gages and/or historic water quality datasets or due to assessment unit comments in the 303(d) List of Assessed Waters and/or staff observation and suggestion, were selected to test the approach adapted from North Carolina. The results of this collection effort were used to develop a draft version of the protocol. The methodology was then beta tested during the 2009 field season using data collected from an additional 32 sites across a range of hydrologic and ecological conditions (Table 1).

Data from perennial, intermittent, and ephemeral streams were assessed using analysis of variance (ANOVA). The ANOVA procedure is one of the most powerful statistical techniques and is used to test the hypothesis that the means among two or more groups are equal. This analysis was used to verify which field indicators are useful in differentiating hydrologic systems in New Mexico by determining if the variation between groups was statistically significant (Table 2). Based on the results of this analysis a number of indicators were either removed from the protocol because they were not significant or their use was limited to applying only when they are observed (see Table 2 for details).

With relevant indicators being set, the final task was to develop numeric thresholds for distinguishing among ephemeral, intermittent and perennial waters. The minimum and maximum total score in each waterbody class were determined (Table 2) and the distribution of total scores was evaluated. It was quite evident by the data that there were scores that strictly fell within one particular waterbody type (ephemeral, intermittent, or perennial) and scores that overlapped between the different groups (Figure 1). From this

* North Carolina Division of Water Quality (NCDWQ). 2005. Identification methods for the origins of intermittent and perennial streams. Version 3.1. North Carolina Department of Environment and Natural Resources, Division of Water Quality. Raleigh, NC.

review, a minimum total score of 9.0 is set as a guideline to distinguish ephemeral channels from non-ephemeral ones. In addition, a Level 1 score greater than 22.0 should be used to distinguish 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 3 summarizes the numeric thresholds for distinguishing among ephemeral, intermittent and perennial waters. Unfortunately, the dataset is not large enough at this time to perform a distribution analysis to evaluate the fit of the score ranges in Table 3.

The *Hydrology Protocol* is considered to be an evolving, living document. This draft version will open for public comment in August 2009. The protocol will be revised and finalized based on comments received. SWQB will continue to review and evaluate the *Hydrology Protocol* on a biennial basis as part of our review of Water Quality Assessment methodologies.

In the event that new data indicate the threshold values used in this protocol are not appropriate and/or if new standards are adopted, the protocol and related threshold values and differentiating scores will be reviewed and adjusted accordingly. As with our review of Assessment Methodologies the revised protocol will be made available for public comment prior to final adoption.

Table 1. Site List for *Hydrology Protocol*

STATION NAME (Stream Gage ID, if applicable)	STORET ID	WATERBODY TYPE	Ecoregion	Date Evaluated
2008 Sites				
Eagle Creek at CR 33 near Dunken	*new station*	EPHEMERAL STREAM	Plains	10/28/2008
Pueblo Canyon abv Bayo WWTP outfall	28Pueblo002.6	EPHEMERAL STREAM	Mtns/Xeric	7/21/2008
San Pablo Canyon abv Rio Puerco	33SPablo000.2	EPHEMERAL STREAM	Mtns/Xeric	9/18/2008
Guaje abv Rendija (E089)	28GuajeC007.2	EPHEMERAL STREAM	Xeric	7/22/2008
Arroyo Chamiso at Avenida de las Campanas	*new station*	EPHEMERAL STREAM	Xeric	6/25/2008
Rio Salado at NM 550 Nature Trail	*new station*	EPHEMERAL STREAM	Xeric	9/10/2008
Canon de Valle abv SR 501 (E253)	30CValle006.0	EPHEMERAL STREAM	Mountains	7/22/2008
Arroyo San Jose abv Hwy 96	*new station*	EPHEMERAL STREAM	Mountains	9/16/2008
Apache Creek	80Apache001.5	INTERMITTENT STREAM	Mountains	10/9/2008
Water Canyon abv SR 501 (E252)	30WaterC016.6	INTERMITTENT STREAM	Mountains	7/21/2008
Santa Fe River blw Frenchie's Field	30SantaF044.5	INTERMITTENT STREAM	Mtns/Xeric	6/26/2008
Senorito Creek blw Nacimiento Mine	33Senori006.8	INTERMITTENT STREAM	Mtns/Xeric	9/18/2008
Carlisle Creek below Carlisle Mine	78Carlis022.3	INTERMITTENT STREAM	Mtns/Xeric	10/7/2008
Rio Penasco at NM 24 bridge near Dunken	59RPenas108.4	PERENNIAL STREAM	Plains	10/28/2008
Vallecito Ck at Paliza Campground	31RValle015.5	PERENNIAL STREAM	Mountains	9/10/2008
La Jara Creek abv irrigation diversion	33LaJara009.7	PERENNIAL STREAM	Mountains	9/16/2008
Nacimiento Creek at Eureka Rd. crossing	33Nacimi008.0	PERENNIAL STREAM	Mountains	9/16/2008
San Francisco River at Luna	80SanFra154.1	PERENNIAL STREAM	Mountains	10/8/2008
Whitewater Creek abv campground	80WhiteW008.8	PERENNIAL STREAM	Mountains	10/8/2008
Trout Creek at FR 19 bridge	80TroutC002.1	PERENNIAL STREAM	Mountains	10/9/2008
Lower Santa Fe River Preserve	30SantaF030.5	PERENNIAL STREAM	Xeric	6/25/2008
Galisteo Creek in Galisteo	30Galist050.4	PERENNIAL STREAM	Xeric	9/9/2008
Galisteo Creek at Hwy 14 near Cerrillos	30Galist030.9	PERENNIAL STREAM	Xeric	9/9/2008
Jemez River abv San Ysidro at NM 4	31JemezR037.0	PERENNIAL STREAM	Xeric	9/10/2008
Gila River at NM 92 Bridge	78GilaRi011.5	PERENNIAL RIVER	Xeric	10/7/2008
2009 Sites				
Rio Peñasco at Dayton, NM	59RPenas009.1	EPHEMERAL STREAM	Plains	Sep-09
Rio Peñasco near Helena Road	59RPenas090.0	EPHEMERAL STREAM	Mountains	Sep-09
Rito de los Pinos @ USFS gate on FR 95	33RPinos006.8	EPHEMERAL STREAM	Mountains	6/16/2009
Tijeras Arroyo near Albuquerque, NM (08330600)	32Tijera000.1	EPHEMERAL STREAM	Xeric	6/25/2009

Table 1. Site List for *Hydrology Protocol*

STATION NAME (Stream Gage ID, if applicable)	STORET ID	WATERBODY TYPE	Ecoregion	Date Evaluated
2009 Sites, *continued…*				
Galisteo Creek blw Galisteo Dam (08317950)	*new station*	EPHEMERAL STREAM	Xeric	6/25/2009
Rocky Arroyo at Hwy bridge nr Carlsbad (08401900)	*new station*	EPHEMERAL STREAM	Xeric	Sep-09
Dark Canyon at Carlsbad, NM (08405150)	*new station*	EPHEMERAL STREAM	Xeric	Sep-09
Revuelto Creek nr Logan, NM (07227100)	11Revuel003.9	INTERMITTENT STREAM	Plains	7/1/2009
Tinaja Creek above Canadian River	04Tinaja010.1	INTERMITTENT STREAM	Plains	6/9/2009
Perico Creek blw Hwy 402	14Perico012.3	INTERMITTENT STREAM	Plains	6/30/2009
Pueblo Canyon abv SR 502 (E060)	28Pueblo000.3	INTERMITTENT STREAM	Mtns - Xeric	6/4/2009
Cebolla Creek (Rio Pescado to headwaters)	*new station*	INTERMITTENT STREAM	Xeric - Mtns	5/19/2009
Santa Fe River below Cerro Gordo Rd	30SantaF052.4	INTERMITTENT STREAM	Xeric - Mtns	5/13/2009
Rio Nutria above Tampico Draw	75RNutri030.2	INTERMITTENT STREAM	Mountains	5/20/2009
Rio Fernando de Taos at Hwy 64 bridge	28RFerna031.7	INTERMITTENT STREAM	Mountains	Sep-09
Gallinas Creek at Lower Gallinas Camground	45Gallin021.5	INTERMITTENT STREAM	Mountains	5/26/2009
Cold Springs Creek above Mimbres R.	45ColdSp009.3	INTERMITTENT STREAM	Mountains	5/26/2009
San Miguel Arroyo @ old Hwy 44	33SanMig005.7	INTERMITTENT STREAM	Xeric	6/17/2009
Rito Leche at Cubita Rd	33RLeche001.3	INTERMITTENT STREAM	Xeric	6/16/2009
Shumway at Hwy 64 bridge	67Shumwa002.4	INTERMITTENT STREAM	Xeric	6/17/2009
Canadian River at NM 104 at milemarker 88	09Canadi144.5	PERENNIAL RIVER	Plains	7/1/2009
Seneca Creek abv Clayton Lake	16Seneca043.0	PERENNIAL STREAM	Plains	6/30/2009
Rayado Creek near Cimarron, NM (07208500)	05Rayado033.8	PERENNIAL STREAM	Plains	Sep-09
Coyote Creek near Golondrinas, NM (07218000)	07Coyote004.2	PERENNIAL STREAM	Plains	Sep-09
Vermejo River near Dawson, NM (07203000)	04Vermej038.8	PERENNIAL STREAM	Mountains	6/9/2009
Ponil Creek near Cimarron, NM (07207500)	05PonilC025.5	PERENNIAL STREAM	Mountains	Sep-09
Rio Nutria near Ramah, NM (09386900)	75RNutri028.0	PERENNIAL STREAM	Mountains	5/20/2009
Tesuque Crk abv diversions nr Santa Fe (08302500)	28Tesuqu023.4	PERENNIAL STREAM	Mountains	6/4/2009
Pecos River at Windy Bridge (08378500)	*new station*	PERENNIAL STREAM	Mountains	Sep-09
La Plata River near Farmington, NM (09367500)	67LaPlat000.3	PERENNIAL RIVER	Xeric	6/17/2009
Animas River at Farmington, NM (09364500)	66Animas001.7	PERENNIAL RIVER	Xeric	6/17/2009
Pecos R blw Dark Canyon at Carlsbad (08405200)	60PecosR093.2	PERENNIAL RIVER	Xeric	Sep-09

Table 2. Average Field Scores of *Hydrology Protocol* Stream Indicators

Stream Indicator	Waterbody Type		
	Ephemeral	Intermittent	Perennial
1.1 Water in Channel [A]	0.18	3.18	5.53
1.2 Fish [A]	0	0.21	1.42
1.3 Benthic Macroinvertebrates [A]	0	1.15	2.22
1.4 Filamentous Algae/Periphyton [A]	0	1.06	2.03
1.5 Differences in Vegetation [A]	0.91	2.09	2.63
1.6 Absence of Upland Plants in Streambed [A]	1.96	2.32	2.92
1.7 Sinuosity [A]	0.77	1.28	1.63
1.8 Entrenchment Ratio [A]	0.68	1.72	1.89
1.9 Riffle-Pool Sequence [A]	0.09	0.79	1.86
1.10 Particle Size or Substrate Sorting [A]	0.61	0.85	2.42
1.11 Hydric Soils [A]	0.27	0.35	2.00
1.12 Sediment on Plants/Debris [B]	0.32	0.62	0.81
1.13 Seeps and Springs [NS, ^]	0	0.29	0.39
1.14 Iron-oxidizing Bacteria/Fungi [NS, ^]	0	0.18	0.33
MINIMUM TOTAL SCORE	**2.00**	**9.00**	**19.5**
MAXIMUM TOTAL SCORE	**11.3**	**21.0**	**32.0**
AVERAGE TOTAL SCORE	**5.80**	**15.3**	**26.5**
Continuous Bed and Bank [NS, *]	2.35	2.35	2.84
Leaf Litter [NS, *]	1.03	0.95	1.25
Braided Channel [NS, *]	0.25	0	0.50

NOTES: [A] *Difference is significant at p<0.005 level*
[B] *Difference is significant at p<0.01 level*
[NS] *Difference is not significant*
[^] *Field indicator was not statistically significant between waterbody types but may be useful in the determination of perenniality, thus it was included in the protocol as a supplemental indicator only.*
[*] *Field indicator was evaluated in the field but was not useful in differentiating hydrologic systems in New Mexico, thus it was not included in the protocol.*

Figure 1. Distribution of Total Scores used to determine threshold ranges

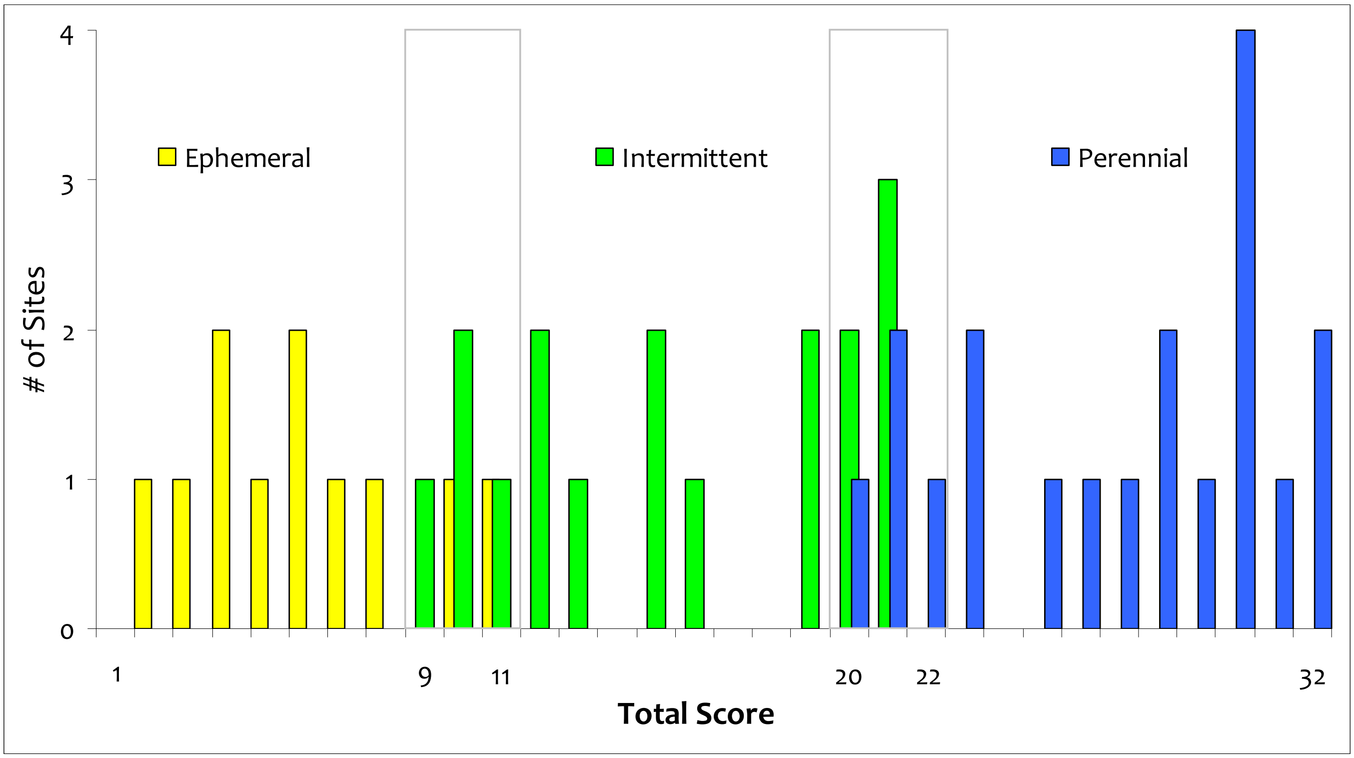

Table 3. Summary of Score Interpretation

Waterbody Type	Level 1 Total Score	Stream 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.

APPENDIX B:

FIELD SHEETS

NMED Surface Water Quality Bureau – LEVEL 1 Stream Determination Field Sheet

Date:	**Stream Name:**	**Latitude:**
Evaluator(s):	**Site ID:**	**Longitude:**
TOTAL POINTS: *Stream is at least intermittent if ≥ 12*	**Assessment Unit:**	**Drought Index (12-mo. SPI Value):**

WEATHER CONDITIONS	**NOW:** ___ storm (heavy rain) ___ rain (steady rain) ___ showers (intermittent) ___ %cloud cover ___ clear/sunny	**PAST 48 HOURS:** ___ storm (heavy rain) ___ rain (steady rain) ___ showers (intermittent) ___ %cloud cover ___ clear/sunny	**Has there been a heavy rain in the last 48 hours?** ___ **YES** ___ **NO** **Field evaluations should be performed <u>at least</u> 48 hours after the last known major rainfall event. **<u>OTHER</u>:** **Stream Modifications** ___ **YES** ___ **NO** **Diversions** ___ **YES** ___ **NO** **Discharges** ___ **YES** ___ **NO** **Explain in further detail in NOTES section

INDICATOR	**STREAM CONDITION**			
	Strong	**Moderate**	**Weak**	**Poor**
1.1. Water in Channel	Flow is evident throughout the reach. Moving water is seen in riffle areas but may not be as evident throughout the runs.	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.	Dry channel with standing pools. There is some evidence of base flows (i.e. riparian vegetation growing along channel, saturated or moist sediment under rocks, etc	Dry channel. No evidence of base flows was found.
	6	**4**	**2**	**0**
1.2. Fish	Found easily and consistently throughout the reach.	Found with little difficulty but not consistently throughout the reach.	Takes 10 or more minutes of extensive searching to find.	Fish are not present.
	3	**2**	**1**	**0**
1.3. Benthic Macroinvertebrates	Found easily and consistently throughout the reach.	Found with little difficulty but not consistently throughout the reach.	Takes 10 or more minutes of extensive searching to find.	Macroinvertebrates are not present.
	3	**2**	**1**	**0**
1.4. Filamentous Algae/Periphyton	Found easily and consistently throughout the reach.	Found with little difficulty but not consistently throughout the reach.	Takes 10 or more minutes of extensive searching to find.	Filamentous algae and/or periphyton are not present.
	3	**2**	**1**	**0**
1.5. Differences in Vegetation	Dramatic compositional differences in vegetation are present between the stream banks and the adjacent uplands. A distict riparian vegetation corridor exists along the entire reach – riparian, aquatic, or wetland species dominate the length of the reach.	A distinct riparian vegetation corridor exists along part of the reach. Riparian vegetation is interspersed with upland vegetation along the length of the reach.	Vegetation growing along the reach may occur in greater densities or grow more vigorously than vegetation in the adjacent uplands, but there are no dramatic compositional differences between the two.	No compositional or density differences in vegetation are present between the streambanks and the adjacent uplands.
	3	**2**	**1**	**0**
1.6. Absence of Rooted Upland Plants in Streambed	Rooted upland plants are absent within the streambed/thalweg.	There are a few rooted upland plants present within the streambed/thalweg.	Rooted upland plants are consistently dispersed throughout the streambed/thalweg	Rooted upland plants are prevalent within the streambed/thalweg.
	3	**2**	**1**	**0**
			SUBTOTAL (#1.1 – #1.6)	

If the stream being evaluated has a subtotal ≤ 2 at this juncture, attainment of Clean Water Act Section 101(a)(2) uses is not feasible. The stream is determined to be ephemeral. If the stream being evaluated has a subtotal ≥ 18 at this point, the stream is determined to be perennial. YOU MAY STOP THE EVALUATION AT THIS POINT. If the stream has a subtotal between 2 and 18 continue the Level 1 Evaluation.

INDICATOR	STREAM CONDITION			
	Strong	**Moderate**	**Weak**	**Poor**
1.7. Sinuosity	Ratio > 1.4. Stream has numerous, closely-spaced bends, few straight sections.	Ratio < 1.4. Stream has good sinuosity with some straight sections.	Ratio < 1.2. Stream has very few bends and mostly straight sections.	Ratio = 1.0. Stream is completely straight with no bends.
	3	**2**	**1**	**0**
1.8. Entrenchment Ratio	Ratio > 2.5. Stream is slightly entrenched.	Ratio between 1.2 and 2.5. Stream is moderately entrenched.		Ratio < 1.2. Stream is entrenched.
	3	**1.5**		**0**
1.9. In-Channel Structure: Riffle-Pool Sequence	Demonstrated by a frequent number of riffles followed by pools along the entire reach. There is an obvious transition between riffles and pools.	Represented by a less frequent number of riffles and pools. Distinguishing the transition between riffles and pools is difficult.	Stream shows some flow but mostly has areas of pools <u>or</u> of riffles.	There is no sequence exhibited.
	3	**2**	**1**	**0**
SUBTOTAL (#1.1 – #1.9)				

If the stream being evaluated has a subtotal ≤ 5 at this juncture, attainment of Clean Water Act Section 101(a)(2) uses is not feasible. The stream is determined to be ephemeral. If the stream being evaluated has a subtotal ≥ 21 at this point, the stream is determined to be perennial. YOU MAY STOP THE EVALUATION AT THIS POINT. If the stream has a subtotal between 5 and 21 continue the Level 1 Evaluation.

INDICATOR	Strong	Moderate	Weak	Poor
1.10. Particle Size or Stream Substrate Sorting	Particle sizes in the channel are noticeably different from particle sizes in areas close to but not in the channel. There is a clear distribution of various sized substrates in the stream channel with finer particles accumulating in the pools, and larger particles accumulating in the riffles/runs.	Particle sizes in the channel are moderately similar to particle sizes in areas close to but not in the channel. Various sized substrates are present in the stream channel and are represented by a higher ratio of larger particles (gravel/cobble).		Particle sizes in the channel are similar or comparable to particle sizes in areas close to but not in the channel. Substrate sorting is not readily observed in the stream channel.
	3	**1.5**		**0**
1.11. Hydric Soils	Hydric soils are found within the study reach.		Hydric soils are <u>not</u> found within the study reach.	
	Present = 3		**Absent = 0**	
1.12. Sediment on Plants and Debris	Sediment found readily on plants and debris within the stream channel, on the streambank, and within the floodplain throughout the length of the stream.	Sediment found on plants or debris within the stream channel although it is not prevalent along the stream. Mostly accumulating in pools.	Sediment is isolated in small amounts along the stream.	No sediment is present on plants or debris.
	1.5	**1**	**0.5**	**0**
TOTAL POINTS (#1.1 – #1.12)				

SUPPLEMENTAL INDICATORS: **The following indicators do not occur consistently throughout New Mexico but may be useful in the determination of perenniality. <u>If the indicator is present</u> record score below and tally with previous score to compute TOTAL.**

1.13. Seeps and Springs	Seeps and springs are found within the study reach.
	Present = 1.5
1.14. Iron Oxidizing Bacteria/Fungi	Iron-oxidizing bacteria and/or fungi are found within the study reach.
	Present = 1.5
TOTAL *plus* SUPPLEMENTAL POINTS (#1.1 – #1.14)	

NMED Surface Water Quality Bureau – LEVEL 1 Stream Determination Field Sheet

Photo Descriptions and NOTES

Photo #	Description (US, DS, LB, RB)	Notes

NOTES:

LEVEL 1 Field Measurements

Pebble Count Tally Sheet

Site Name:____________________ **Storet ID:**____________________

Date:____________________ **Crew:**____________________

Substrate Type	Diameter Range (mm)	In-Channel COUNT	In-Channel % Composition	Out of Channel COUNT	Out of Channel % Composition
Silt/Clay	< 0.06 mm				
Sand	0.06 – 2.0 mm (gritty)				
Gravel	2.0 – 64 mm				
Cobble	64 – 256				
Boulder	> 256 mm				
Bedrock	---				

****Please be sure to measure at least 50 pebbles (10 in 5 transects or 5 in 10 transects-depending on stream size) for accurate distributional representation****

ENTRENCHMENT MEASUREMENTS & CALCULATIONS**							
Max Depth (#1)	**Bankfull Stage (#2)**	**Maximum Depth Value (#3)**	**2x Maximum Depth Value (#3)**	**Flood-Prone Area Location (#4)**	**Flood-Prone Area Width(#5)**	**Bankfull Width(#6)**	**Entrenchment Ratio** (FPA Width / Bankfull Width)

****REFER to Figure 3 on page 16 for clarification**

NMED Surface Water Quality Bureau –
LEVEL 2 Stream Determination Field Sheet
****Borderline Cases****

Date:	**Stream Name:**	**Latitude:**
Evaluator(s):	**Site ID:**	**Longitude:**
LEVEL 1 Total Points: **LEVEL 2 TOTAL POINTS:**	**Assessment Unit:**	**Drought Index (12-mo. SPI Value):**

WEATHER CONDITIONS	**NOW:** ___ storm (heavy rain) ___ rain (steady rain) ___ showers (intermittent) ___ %cloud cover ___ clear/sunny	**PAST 48 HOURS:** ___ storm (heavy rain) ___ rain (steady rain) ___ showers (intermittent) ___ %cloud cover ___ clear/sunny	**Has there been a heavy rain in the last 48 hours?** ___ **YES** ___ **NO** **Field evaluations should be performed <u>at least</u> 48 hours after the last known major rainfall event. **<u>OTHER</u>:** **Stream Modifications** ___ **YES** ___ **NO** **Diversions** ___ **YES** ___ **NO** **Discharges** ___ **YES** ___ **NO** ****Explain in further detail in NOTES section

A. Hydrology (Subtotal = ______)	**Poor**	**Weak**	**Moderate**	**Strong**
2.1. Water in Channel (OPTIONAL)	0	1	2	3
2.2. Hyporheic Zone/Groundwater Table	0	1	2	3

B. Biology (Subtotal = ______)	**Poor**	**Weak**	**Moderate**	**Strong**
2.3. Bivalves	**Absent** = 0		**Present** = 3	
2.4. Amphibians	**Absent** = 0		**Present** = 3	
2.5. Macroinvertebrates (abundance/diversity)**	0	1	2	3
2.6. EPT Taxa**	**Absent** = 0		**Present** = 3	
2.7. Fish	0	1	2	3

** Macroinvertebrates and EPT Taxa should not be scored until identification and enumeration has been performed in a laboratory setting by a qualified aquatic biologist/environmental scientist.

Photo #	**Description (US, DS, LB, RB)**	**Notes**

<u>NOTES</u>: (use back-side of this form for additional notes)

____

____

Thermograph Deployment/Download/Retrieval Field Sheet

(Last Revision 01/03/2007)

Thermograph #: **HOBO / StowAway** ____________________

Staff at deployment: ____________________

Assessment unit: ____________________

Water Quality Standards segment: **20.6.4.** ____________________

Station name/STORET ID: ____________________

Location description:

Lat/Long: ____________________ **GPS: Y / N**

Date/time deployed: ____________________

Medium: **Water / Air**

Estimate % shade on thermograph: ________

Download record:	Date	Time removed	Time replaced	Staff	Comments
Download 1					
Download 2					
Download 3					
Download 4					
Retrieval:					

File name: ____________________

Additional comments:

Cross section sketch:

Plan view sketch:

Write good directions, draw a good site map, and note triangulation distances.

Take photos from 2 angles (have someone point to or stand next to the thermograph):

PHOTO 1 Description ____________________

PHOTO 2 Description ____________________

FISH SAMPLING FIELD DATA SHEET

Stream name:		MSB Field No.
Location:		Station ID
Lat N_____________ Lon W_________________ GPS?	River basin:	
Elevation __________ m	Investigators:	
Designated Use:	Agency:	
Form completed by:	Date: Time:	Reason for survey:

SAMPLE COLLECTION	**Gear** ❑ back pack (Model: ________________) ❑ seine (Size/mesh: _____________) ❑ other ____________ **Block nets used?** ❑ Upstream ❑ Downstream ❑ None **Barrier extant?** ❑ Upstream ❑ Downstream **Sampling Duration** Start time __________ End time __________ Shock seconds __________ **Stream width (m)** Max_______Mean_______ **Reach length (m)** ________ **Passes:** ________ Specific conductance ________µS/cm Shocker voltage__________ Shocker settings__________ Water temp _______°C Coincident with habitat survey? ❑ Yes ❑ No Reference reach candidate? ❑ Yes ❑ No
HABITAT TYPES	**Indicate the percentage of each habitat type present** ❑ Riffles_____% ❑ Pools_____% ❑ Runs_____% ❑ Snags_____% ❑ Submerged Macrophytes_____% ❑ Other ( )_____%
GENERAL COMMENTS	

SPECIES	TOTAL (COUNT)	OPTIONAL: Length (mmTL)/Weight (g) (40 SPECIMEN SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z

SPECIES	TOTAL (COUNT)	OPTIONAL: Length (mmTL)/Weight (g) (40 SPECIMEN SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z

* **ANOMALY CODES:** D = deformities; E = eroded fins; F = fungus; L = lesions; M = multiple DELT anomalies; S = emaciated; T = tumor; Z = other