Stream Condition Inventory (SCI)
Technical Guide
Pacific Southwest Region

July 2005

United States
Department of
Agriculture

Forest Service

Version 5.0

Acknowledgements

Special thanks and recognition are extended to those who have contributed extensively to the content of this publication:

The initial SCI development team, for research, writing, field-testing and analysis: Dave Azuma, Jerry Boberg, Ann Carlson, Jim Frazier, Dave Fuller, Karen Kenfield, Jeff Reiner, and Ken Roby;

The recent SCI revision team, for updating attributes, improving protocols and procedures, and editing the document: Sharon Grant, Joseph Furnish, Brian Staab, and initial team members Frazier, Roby, Kenfield and Boberg.

Together they have completed the task of producing the Pacific Southwest Region Stream Condition Inventory Technical Guide.

Suggested Citation

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Cover Photos

South Fork Stanislaus River at Fraser Flat, Stanislaus National Forest.

Illustrations

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I. Overview

A. Introduction

The purpose of the Pacific Southwest Region Stream Condition Inventory (SCI) is to collect intensive and repeatable data from stream reaches to document existing stream condition and make reliable comparisons over time within or between stream reaches. SCI is therefore an inventory and monitoring program. It is designed to assess effectiveness of management actions on streams in managed watersheds (non-reference streams), as well as to document stream conditions over time in watersheds with little or no past management or that have recovered from historic management effects (reference streams).

SCI Objectives:

Inventory stream reaches using standard, measurable protocols to collect consistent region-wide existing stream condition data.

Monitor stream reaches over time to compare conditions within or between reaches at a reasonable level of statistical confidence (generally the detection of a 20% change with an 80% confidence level).

B. Background

The SCI technical guide was developed beginning in 1993 by a Pacific Southwest Region team of hydrologists, fisheries biologists, and a mathematical statistician from the regional research station. The intent was to select stream condition attributes and establish attribute measurement protocols that could be used across forest boundaries so that information could be shared across the region. Several criteria were established for selecting attributes:

- Attributes were demonstrated through research to be able to detect change resulting from management
- Attributes could be sampled by field crews
- Attributes had a small enough measurement error to be useful in describing differences with a moderate to high level of confidence (detecting a 20% change with a confidence of 80%)

A review of established attributes and protocols was conducted and a subset of the most promising was selected for pilot testing. Development of a protocol for streambank stability was conducted using several references.

Pilot testing was conducted in 1993 and 1994, during which a variety of channel lengths and protocols were evaluated at numerous sites in the region. Testing resulted in two preliminary SCI documents, Versions 1.0 and 2.0. An overview of the pilot testing preliminary results, plus a discussion of analysis and interpretation of the data, is included in Appendix A.

SCI became regionally operational in 1995 as Version 3.0. Minor changes in protocols occurred over the next three years and SCI Version 4.0 was published in 1998. Protocols, procedures and attributes remained the same until 2003 when a document review and revision was undertaken to update attributes, protocols, and procedures. The result is this technical guide, SCI Version 5.0.

C. Components of the SCI

Attributes

The SCI consists of stream features, or attributes, that are useful in classifying channels, evaluating the condition of stream morphology and aquatic habitat, and making inferences about water quality. Attributes are collected at selected reaches on streams of interest. Reaches are monumented to reduce variability when measurements are repeated.

Attributes are classified as either core or optional. Core attributes should be measured on every SCI reach to facilitate analysis at large scales. Local objectives and needs may necessitate collection of additional data. Because there is considerable variation over time and between sites with most stream attributes, it is recommended that all core attributes be collected at each site to provide a strong basis of comparison.

Protocols

Each attribute has a protocol for field measurement. The protocol describes the attribute's importance, objectives, and specific instructions on how and where to take measurements. The protocols are the keystone to the success of SCI since accurate data collection over time is essential.

Inventory Procedures

Procedures for conducting SCI in the field are the operational part of the technical guide. There are procedures that describe how to prepare for field work (watershed and stream reach identification), doing the field work (a pass sequence approach), and what to do after the fieldwork is completed (data check and data entry).

Quality Assurance/Quality Control

The QA/QC Plan in the technical guide is intended to improve quality of SCI data. It is essential for data to be collected accurately in order to be able to meet SCI objectives.

D. Inventory and Monitoring Design

Inventory

The SCI attributes and protocols are designed to measure a suite of characteristics for inventorying stream condition at a specific time and place. SCI consists of established and proven stream assessment techniques that are organized into a package that can be measured in the field in a complimentary and time-effective manner. SCI is thus designed to inventory many stream condition attributes in one visit to a stream reach.

SCI is primarily designed for use on wadable, perennial streams with gradients up to about 10%.

Establishing SCI reaches typically requires two to three days with a crew of two or three, depending on travel time and crew experience. Remeasurement of reaches requires slightly less time.

Monitoring

In recent years there have been numerous studies that have evaluated the repeatability of protocols, especially in relation to large-scale monitoring efforts (Archer et al. 2004). In setting up a monitoring location, it is important to understand the variability associated with stream reaches, as well as the variability in how observers take measurements. SCI is designed so that reliable repeat measurements can be made at desired intervals to detect change. Quantifiable, objective measurements in each protocol allow for remeasurement at the same location. It is critical that the Quality Assurance/Quality Control section of this document be understood to insure reliance on the data collected.

In addition, when remeasuring SCI reaches, consider any changes that may have been made to these protocols between sampling intervals. This may affect data collection and interpretation.

Data Management

SCI is compatible with NRIS. This national system will be used as the data storage and retrieval system when it is available in Region 5.

Limitations

The procedures provided in the SCI technical guide should be considered tools for stream inventory and monitoring. SCI is not intended to provide a complete list of inventory and monitoring attributes given the wide variety of channel and watershed types, beneficial uses of water, aquatic communities, and management activities in the Region. Additional data collection related to specific biota or stream characteristics may be needed to meet local inventory and monitoring objectives. Examples of such attributes include amphibians, stream longitudinal profile, chemical or physical water quality, range utilization, green-line, and fish spawning success.

Application of SCI to large rivers or very small streams should be undertaken with caution. In such cases, monitoring objectives and questions should be carefully evaluated before inventory is begun. Variables such as deep pools in large rivers make implementing some protocols problematic, and employee safety is an issue. Some SCI protocols are applicable to intermittent streams and some others are not. Selection of intermittent streams should consider the effects of a limited data set on the ability to interpret data. Likewise, several SCI attributes provide measures of channel morphology most applicable to low gradient channels. Application of SCI to high gradient streams should be undertaken with the knowledge that attributes sensitive to change may be different from low gradient streams; however, application of SCI in steeper, more resilient channels has been successful. Careful evaluation of inventory and monitoring objectives should be considered before conducting SCI on high gradient streams.

E. Relation to Other Inventories and Programs

Inventory and Monitoring Levels

SCI fits within a framework of inventory and monitoring tools available to Pacific Southwest Region watershed and aquatic specialists. Conceptually, these tools fit into four increasingly intensive levels of inventory and monitoring:

Level 1. Office Level – Maps, aerial photography, and other existing data are used to characterize watershed and stream attributes, such as area, geology, gradient, and valley width. This is a first step in designing plans for field inventory or monitoring.

Level 2. Field Extensive Level – A basin level field inventory is conducted to determine distribution of aquatic species, riparian condition, channel types and fish habitat, and location of stream improvement opportunities.

Level 3. Field Intensive Level – This is SCI, a field inventory and monitoring protocol intensive enough to provide reliable comparisons over time within or between streams across the region.

Level 4. Project Level – This is project/site specific monitoring, based on plans developed to address specific questions. It includes in-channel monitoring required by the R5 Best Management Practices Evaluation Program (BMPEP). In some cases, SCI protocols may be the appropriate tool to address Level 4 monitoring questions.

Related Assessment and Monitoring Programs

SCI is a portion of the larger task of ecosystem inventory, monitoring, and analysis. It has analytical application in conjunction with resource inventories that provide like data for other ecosystem components (i.e. Soil Surveys, Ecological Unit Inventory (EUI), Aquatic Ecological Unit Inventory (AEUI), Aquatic and riparian species surveys, Watershed Improvement Needs (WIN) Inventory, etc.). Assessment and evaluations where SCI data can be useful include:

Watershed Assessment/Analysis: The use of SCI as a tool for assessing condition should be spurred by identification of a question or data need posed during the large-scale analysis.

Watershed Condition Assessment: This regional protocol uses a range of objective and subjective indicators to rate the condition of watersheds. WCA may serve to highlight locations where data provided by SCI might be most useful. Existing data sources are used to support ratings made in the WCA. SCI data can provide a basis for the elements related to channel condition.

LRMP Monitoring: SCI data should be extremely useful in evaluating trends in condition over time. It therefore has utility in long-term monitoring associated with Forest Plans.

BMPEP In-Channel Monitoring: BMPEP directs each R5 forest to have at least one in-channel assessment of BMP effectiveness each year. SCI might be extremely useful for this purpose, dependent upon the specific questions associated with the project and stream selected.

Project Level Monitoring: The need for monitoring trends in channels before and after project implementation may be identified during project planning. Again, SCI might be an appropriate tool for such monitoring.

F. Relation to Forest Service Handbooks

The following is a list of current Regional and National handbooks that codify the agency's policy, practice, and procedures in relationship to aquatic systems:

Ecosystem Classification Handbook (FSH 2090.11): This handbook is reserved and is still to be developed, however it is anticipated that data collected through SCI would provide useful information for classification of aquatic ecological types.

Water Resource Inventory Handbook (FSH 2509.16): The SCI technical guide complements both Sections 1.2 (inventory) and 1.3 (evaluation and monitoring) of the Water Resource Inventory Handbook.

Water Information Management System Handbook (FSH 2509.17): The SCI technical guide provides useful information for managing water systems on National Forest lands. SCI procedures can help with floodplain delineation (Chapter 20). Applicable information collected through SCI inventory and monitoring includes, but is not limited to: channel cross-sections, percent fines, and residual pool depths.

Soil and Water Conservation Handbook (R5 FSH 2509.22): The SCI technical guide complements Chapters 10, 20, 30, and 40 of the Soil and Water Conservation Handbook. SCI inventory and monitoring helps with water quality management including best management practices evaluation (BMP) for National Forest lands in California (Chapter 10).

Specifically, SCI provides a means of completing in-channel evaluations required by the R5 BMPEP technical guide. Information collected through the SCI procedures assist with cumulative watershed effects analysis (CWE, Chapter 20). SCI information available for CWE analysis includes but is not limited to, stream channel processes, stream channel response, beneficial uses of water, water quality criteria necessary to protect specific beneficial uses, and channel attributes. Since SCI can be a monitoring tool, it is useful for determining effectiveness of stream management zones and land management activities in protecting riparian and aquatic resources (Chapter 30 & 40).

Water Resource Investigations (FSH 2531, R5 FSH 2531.3): There are three levels identified for water resource investigations. SCI is useful for providing information at all levels.

Water Quality Management (FSH 2532, R5 FSH 2532.04): The SCI technical guide procedures provide information relating to water quality and aquatic conditions. Specific data collected with SCI that could be used for water quality management include but are not limited to: sediment loading, water temperature, and stream channel stability.

Fisheries Habitat Evaluation Handbook (R5 FSH 2609.23): The inventory and monitoring procedures outlined in the Regional SCI technical guide supplements the existing fisheries habitat assessment procedures. SCI is intended to supplement the FSH 2609.23 Step II Habitat Inventory--Quality and Quantity. This provides an alternative tool for monitoring of streams with greater integration between fisheries and hydrology. SCI provides a greater sampling intensity than the existing FSH 2609.23 Step II procedures (220, 221, 221.1, 221.2, 221.3, 221.4, 221.5, 221.6). SCI Inventory and Monitoring procedures are also intended to supplement the FSH 2609.23 Step III Project Design and Evaluation (230, 231, 231.1, 231.2, 231.3, 231.4, 231.5, 231.6) by providing objective, measurable, repeatable protocols that can be used for monitoring or inventory with a greater level of statistical confidence than existing procedures. In actual application, forest aquatic specialists will choose procedures from both sources and additional procedures to address specific inventory and monitoring situations.

Investigating Water Quality in the Pacific Southwest Region: Best Management Practices Evaluation Program (BMPEP): SCI provides protocols useful in implementing BMPEP In-Channel Evaluation.

G. Data Quality

Recent evaluations of stream monitoring efforts (Roper et al. 2003), as well as experience with SCI during the pilot and draft periods continue to demonstrate the inherent variability of stream systems and the difficulty of monitoring them. The same efforts have reinforced the need for attention to quality control. Quality assurance and control procedures are discussed in Section IV.

H. Data Storage and Retrieval

An important component of having a standardized protocol is the use of a standardized database to facilitate storage and use of the data. SCI data is compatible with the National Resource and Information System (NRIS).