SAMPLING AND ANALYSIS REQUIREMENTS

NUMERIC TARGET MONITORING

SQUAW CREEK TOTAL MAXIMUM DAILY LOAD FOR SEDIMENT,
PLACER COUNTY

Lahontan Regional Water Quality Control Board
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1. DATA COLLECTION SUMMARY

The following shall be collected synoptically (i.e., at the same time) at each site, and on a biennial schedule (i.e., once every two years):

- General sampling site information (date, time, weather, conditions)
- Global Positioning System (GPS) coordinates of site locations
- Site photographs
- Water chemistry data
    - Temperature, dissolved oxygen, pH, conductivity
- Physical habitat data
    - Substrate particle size, water depth, stream width, current velocity
- Benthic macroinvertebrate samples

2. SAMPLING LOGISTICS

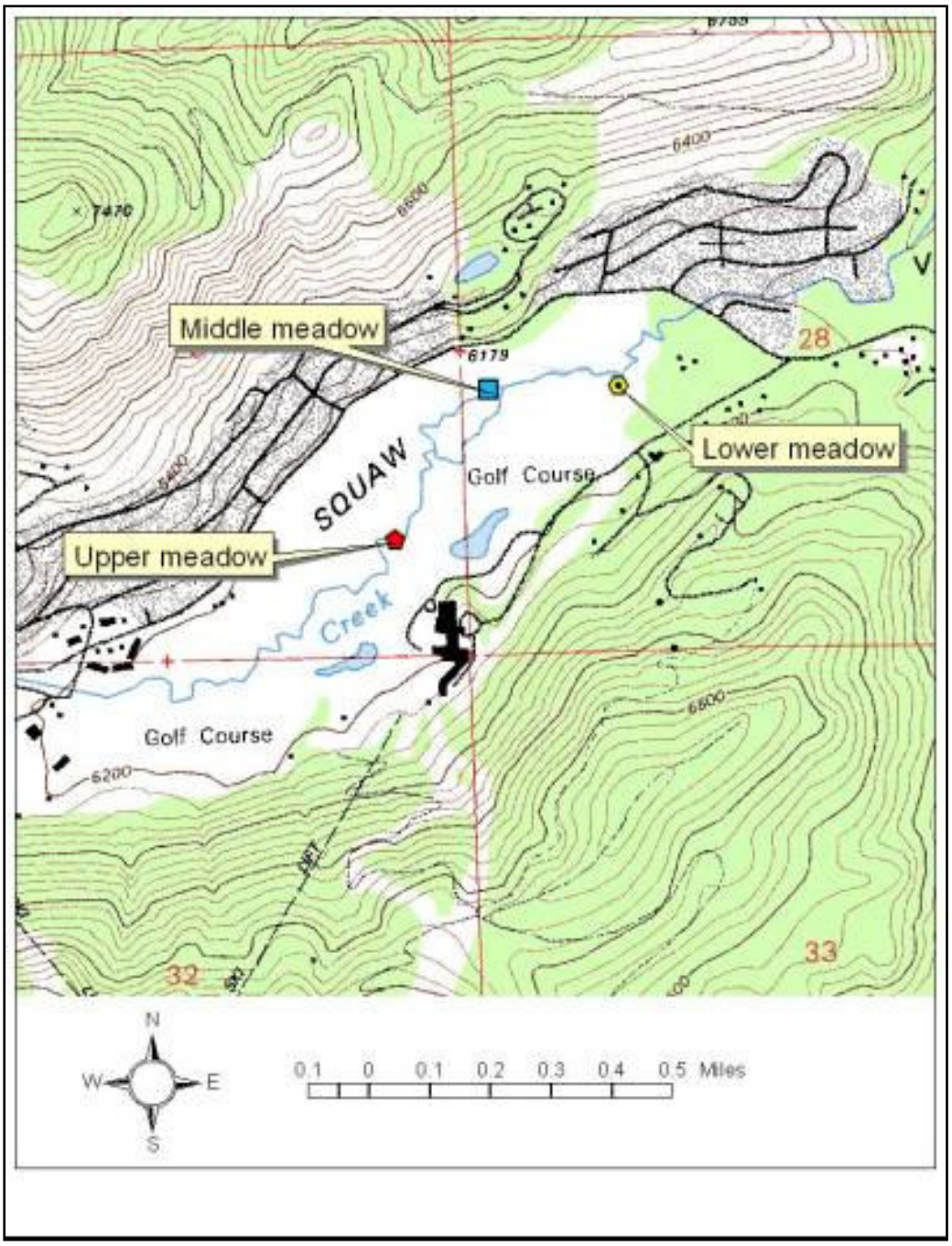
Sample Locations

Bioassessment sampling locations shall duplicate the three sites in the low gradient meadow reach of Squaw Creek sampled in 2000 and 2001 for the Squaw Creek TMDL bioassessment study (Herbst 2002). The UTM coordinates (datum: NAD 1927) for each site established by Herbst are provided in Table 1. The coordinates were recorded at the downstream end of each 150-meter sampling reach. Figure 1 shows the general sampling site locations.

Table 1. Sampling site coordinates. Datum is NAD 1927.

Location	Northing	Easting
Squaw Creek **Upper meadow**	4342814	740091
Squaw Creek **Middle meadow**	4343185	740287
Squaw Creek **Lower meadow**	4343245	740475

Figure 1: Squaw Creek meadow reach numeric target monitoring locations



Sampling Frequency

Sampling shall be conducted once every two years, beginning in 2009.

Sampling Period (also called "Index Period")

Sampling shall occur between the months of June and August, after peak snowmelt flows have subsided, when flows in the meadow reach are continuous and riffle habitat at the sampling sites is present. Target flow conditions are when the high-discharge snowmelt period is over, but before baseflows become so low that no riffle habitat is present. Avoid sampling when flow may be strongly influenced by precipitation, because sudden flow increases may affect local community composition (SWAMP 2007).

Sampling Equipment

(Adapted from Herbst 2001 and 2002, and SWAMP 2007)

- Multi-parameter probe or individual probes (for field measurements of dissolved oxygen, temperature, conductivity, pH)
- Current meter (for stream discharge)
- D-frame kick net (250-micron mesh size)
- BioQuip forceps
- White sorting pan (enamel or plastic)
- 100% ethanol and rose bengal stain
- Sample jars (250 ml or 500 ml)
- Buckets (2) and aquarium nets (fine mesh)
- Meter stick or other graduated rod (for measuring depth and pebble counts)
- Meter tape (50 meters on a reel)
- Data collection sheets/fieldbook
- Flags/flagging Tape
- Camera
- GPS unit
- Small metric ruler or gravelometer for substrate measurements

3. FIELD PROCEDURES

(Adapted from Herbst 2001 and 2002, and SWAMP 2007)

Prepare Sampling Location

1. Define sampling reach

Each sampling site is a 150-meter reach along an approximation of the thalweg (i.e., deepest part) of the channel. To the extent possible, this measurement should be made by following along the bank contours of the channel, laying out the meter tape. This may require crossing the channel or even walking in the stream if bank vegetation cover is too dense – but this should be avoided or kept to an absolute minimum to avoid

disturbance of benthic habitat. Lay out the 150-meter reach starting at zero at downstream end of reach.

2. Record reach information

Once the 150-meter reach is delineated, record GPS UTM coordinates and datum at the bottom end of the reach. Record date, time, sampling staff, site name (i.e., Squaw Creek upper, middle or lower meadow) and general weather conditions, as well as any other conditions that may influence bioassessment sampling (i.e., recent high flows, scouring events, other stream disturbances, etc.).

3. Take photographs

Photos shall be taken at 0 meters (m) looking upstream, 50 m looking upstream, 100 m looking upstream and 150 m looking downstream. For all photos, record site, date, and transect location of photo (e.g., 0 m looking upstream).

4. Define riffle-pool areas

Over the 150-meter reach, record along the meter tape (to the nearest meter) where erosional and depositional habitat types begin and end – riffles and pools, respectively. This provides an indication of the distribution and length of these major geomorphic features within each reach. The position of these habitat features shall also be used to determine where the benthic invertebrate samples are to be collected by using a random number table (0-150). Specifically, after recording the riffle ranges, select random numbers until five of the random numbers correspond with the riffle ranges, and then sample at those locations. Any habitat not assigned to the riffle-pool categories may be recorded as transitional “glide” or “run” habitat type.

5. Establish transects

Establish fifteen transects, spaced at 10-meter intervals, over the length of the 150-meter sampling reach. Mark transects with surveyor's flags or similar, along a single bank.

Measure and Record Water Chemistry Data

At the top end of the reach, where no instream habitat has been disturbed by the sampling crew, measure and record ambient water chemistry data (i.e., pH, dissolved oxygen, temperature, conductivity).

Collect Benthic Macroinvertebrate Samples

Macroinvertebrate samples shall be collected before recording physical habitat data. Samples shall be collected as composites of 3 kick samples across 5 randomly selected

riffle habitats; therefore, each sampling site will have 5 replicate samples collected for laboratory analyses.

Benthic Macroinvertebrate Sampling Procedure

(Adapted from Herbst 2001, Appendix 2-2)

Select 5 riffles from a random number table (as described above in the subsection titled "Define riffle-pool areas") along the 150-meter reach. Use the D-framed net (250-micron mesh size) to collect kick samples at ¼, ½ and ¾ of the stream width. (Always start at the location furthest downstream and work up.) When selected riffles are wide enough, collect the 3 samples for each composite along a transect that is perpendicular to the stream (i.e., across the stream in a side-by-side manner). For selected riffles that are too narrow to collect all 3 samples along a perpendicular transect, collect the 3 samples one above the other (starting from downstream) as described further, below. Kick an area approximately 30 x 30 cm directly upstream of the net (a square area with sides equal to net width). Continue this kick for about 10-15 seconds, then rub the rocks by hand for an additional 10-15 seconds (total 20-30 seconds at each of 3 positions = 1 to 1.5 minutes). If shallow enough, just use hands for the full time, rather than kicking. After each sample position, remove large rocks or wood debris after washing them in the current into the net.

For streams less than 1-2 meters wide, take 2 kick samples from both sides of the stream with one sample just above and mid-stream, or collect all 3 samples singly (one above another) starting at the random number location (instead of taking all 3 across the stream when widths are greater than 1- 2 meters). Keep in mind that the goal is to sample across different microhabitat types in the stream including varied depth, current, and substrate types; the three composited samples should represent the variety of riffle habitat present. One or two samples may be used to comprise a composite if samples are dense with debris. The label should then indicate the number of kicks used (i.e., 1 or 2); assume 3 if not noted on label. If riffle habitat is not available across the entire line of each transect, select representative locations to collect the needed composite sample.

Quickly dip the net into the stream to consolidate the material to the bottom of the D-framed net. Pick out any remaining large debris being sure to retain any attached insects. Invert the net into a bucket that is 1/4 to 1/3 full of water. Shake out the net to collect all the debris and insects (do not dip in bucket water since insects will adhere). Dip net into the stream again to consolidate remaining contents and flick inverted net into the bucket.

Elutriate (pour off lighter material) with a swirling motion into the other bucket five times. Use only a small volume of water in each elutriation so the receiving bucket does not overflow. Only rocks and sand should be left in the original bucket. Empty these rocks into a shallow white pan (or closely examine the bottom of the bucket). Search for cased caddisflies/snails and add to sample if found (they are heavier and may not pour off).

Strain collected material through a fine mesh aquarium net supported on one bucket (this may also serve as elutriation since some sand usually remains). Empty contents of aquarium net into a sample container. Use BioQuip forceps to scrape any remaining debris into vial. Fill container with ethanol to preserve the captured organisms. Fill to a level that just covers the amount of debris. Add 5 ml of rose bengal stain. Label sample jar as shown below, and move on to next sample.

Label Sample Jars

Record stream name, site name, date, and replicate number. The label shall also indicate the number of kicks used (i.e., 1 or 2) if fewer than 3; assume 3 if not noted on label.

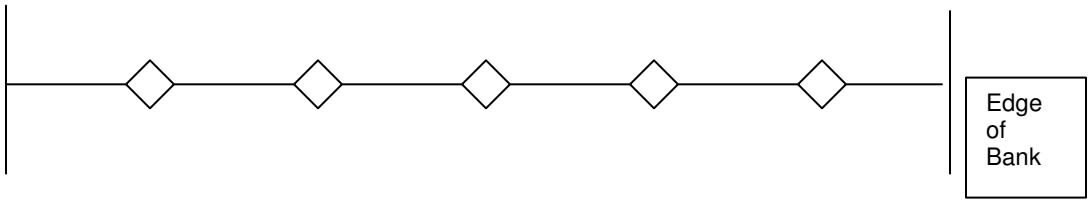
Collect Physical Habitat Data: Percent Fines and Sand, D-50 Particle Size

(From Herbst 2001 and 2002, and SWAMP 2007)

Physical habitat data shall be collected at 5 equidistant points along each of the 15 established transects. Current velocity shall be measured at one selected representative transect at each reach.

1. Measure and record stream width (wetted perimeter) at transect location. Each transect is then visually divided into 5 equally spaced points (visualize the mid-point as 3, and equally divide the left and right sides into points 1 and 2 and points 4 and 5). (Figure 2).

Figure 2. Spacing of transect points.



2. At each of the 5 points along the transect, lower a graduated rod (e.g., meter stick or similar) through the water column perpendicular to both the flow and the transect to objectively select the particle located at the tip of the rod.

3. Measure the depth from the water surface to the top of the particle and record to the nearest centimeter.

4. Remove the particle from the streambed, then measure and record the length of its intermediate axis to the nearest millimeter, and assign to one of the size classes listed below. Alternatively, size may be estimated using descriptions listed below (SWAMP 2007). Record size class using codes listed in the far right column of Table 2.

Table 2. Substrate size descriptions and size class codes.

Substrate	Size (Herbst 2002)	Description (from SWAMP 2007)	Size Class Code
Fines	< 1 mm	Not gritty	F
Sand	1-3 mm	Gritty to ladybug	S
Gravel	3-65 mm (6.5 cm)	Ladybug to marble to tennis ball	G
Cobble	6.5 cm to 25 cm	Tennis ball to basketball	C
Boulder (or bedrock)	>25 cm (10 inches)	Bigger than basketball	B

5. Select one representative transect at each reach to record current velocity. At 60 percent depth, measure the current velocity at each point along the selected transect. Record current meter type used and units. Discharge is calculated as the sum of one-fifth the stream width times the depth and current velocity measured at each of the five transect points.

Stream velocity, depth, and substrate size shall be recorded and reported using the template provided in Attachment 1 (from Herbst 2001, Appendix 1-7, pp. 2-3), or an equivalent method, and stream discharge (width x depth x velocity) shall be reported for each reach. Substrate data shall be entered into the Excel spreadsheet template provided in Attachment 2, and provided to Water Board staff in that electronic format, including values for the D-50 (median) particle size and "percent fines plus sand" calculated for each reach according to the methods and formulas in Attachment 2.

4. LABORATORY ANALYSIS

Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrate Samples

(Adapted from Herbst 2001 and 2002)

Subsample Counts:
Each subsample shall have a minimum organism count of 250. Complete counts shall be performed for any and all subsamples taken. (Average counts will be in the 300-500 range.)

Sample Splitting:
Samples may be split to acquire subsamples using either the grid-tray method or a rotating drum (i.e., Folsom) plankton splitter. Additional background information about the performance characteristics of these and other procedures is available in Herbst and Silldorff (2004).

Sample Identification:
Sorted specimens shall be identified, assigned, and reported using the taxonomic levels shown in Attachment 3 (Calculator for Squaw Cr Biological Targets). Each identification

shall have a taxonomic certainty rating of "1," "2," or "3" assigned to it, to assist in evaluating any problems with taxonomy that may arise (see taxa record sheets in Herbst 2001, Appendix 1-3, for an example template). Life stage(s) and observations of identifying traits or specimen condition shall also be recorded and reported along with the other results.

5. CALCULATION OF COMPONENT METRICS AND THE "BIOLOGICAL CONDITION SCORE" (BCS)

The BCS's seven component metrics (i.e., Biotic Index, Taxa Richness, EPT Diversity Index, %EPT of Total, Number of Sensitive Taxa, % Tolerant Taxa, R-50 Index) shall be calculated using the methods in Attachment 3 ("Calculator for Squaw Cr Biological Targets"). Following calculation of the seven component metrics, the BCS shall be calculated by summing the component metric scores derived using the values in Attachment 3, (from: Herbst 2002, p. 9, table titled "Biological Condition Scores Assigned to Metric Value Ranges").

6. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

The discharger shall prepare and/or make available to its relevant staff and/or consultants a Quality Assurance Project Plan (QAPP) that addresses the required bioassessment monitoring. The QAPP should follow USEPA guidance and requirements as found in *USEPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, EPA/240/B-01-003, March 2001), and *USEPA Guidance for Quality Assurance Project Plans* (EPA QA/G-5, EPA/240/R-02/009, December 2002). Upon request from the discharger, the Water Board's Executive Officer or Quality Assurance Officer may override any USEPA quality assurance requirements and/or guidance that are deemed inapplicable and/or unnecessary for this project. Any such deviations must be approved in writing and in advance by Water Board staff. An umbrella document, such as a Quality Assurance Management Plan or other project or program quality assurance document, may be used to meet this requirement if the umbrella document covers all relevant aspects of the required bioassessment sampling.

The QAPP (or umbrella document) shall include, or be supplemented to include, a specific requirement for external quality assurance checks (i.e., verification of taxonomic identifications and correction of data where errors are identified). External QA checks shall be performed on: (1) all uncertain taxa; and (2) one macroinvertebrate sample per calendar year in which sampling occurs for this project, or ten percent of the samples per year (whichever is greater). QA samples shall be randomly selected. The external QA checks shall be paid for by the discharger, and performed by the California Department of Fish and Game's Aquatic Bioassessment Laboratory. An alternate laboratory with equivalent or better expertise and performance may be used for the external QA checks if approved in advance by the Water Board's QA Officer or Executive Officer.

7. DATA REPORTING

The discharger shall provide, within one year of each sample date, electronic copies (in Microsoft Excel® format) of:

- Spreadsheet with substrate size calculation formulas, providing values for the D-50 particle size and "percent fines plus sand", calculated according to the methods and formulas contained in Attachment 2. (This reporting requirement can be satisfied by completing and submitting the spreadsheet provided in Attachment 2.)
- All raw bioassessment data (i.e., all data for all 5 replicates for each site) in spreadsheet format, reported using the taxonomic levels in Attachment 3. (Note: Deviation from the taxonomic levels in Attachment 3 is not acceptable, since any such deviation could affect the component metrics and final BCS score.) This shall include a separate column of data for each of the five replicates, and a "total" column that sums (composites) the data for all five replicates. (This reporting requirement can be satisfied by completing and submitting the spreadsheet provided in Attachment 3.)
- Metric calculation spreadsheet showing values for the seven BCS component metrics and the final BCS score calculated according to the formulas in Attachment 3. (This reporting requirement can be satisfied by completing and submitting the spreadsheet provided in Attachment 3.)

The discharger shall also provide, concurrently with the data described above, in both hardcopy and electronic (i.e., Adobe PDF) formats, a brief interpretive report including:

- A narrative summary of the results (including calculated Biological Condition Score, D-50 particle size, and "percent fines plus sand") for each site and date, with a tabular comparison of the most recent scores to the TMDL targets and any and all previous monitoring scores (i.e., to clearly display and briefly summarize the trends in target values over time compared to the numeric targets).
- Photocopies of field data sheets and field notes
- Site photographs
- Results of the external QA checks and any action(s) taken to resolve any discrepancies encountered during the QA process.

8. SAMPLE PRESERVATION AND ARCHIVING

Definitions: The "original sample material" is that material (i.e., macroinvertebrates, organic material, gravel, etc.) remaining after the subsample has been removed for identification. The "remaining subsampled material" is that material (i.e., organic material, gravel, etc.) that remains after the organisms to be identified have been removed from the subsample for identification. (Generally, no macroinvertebrates are present in the remaining subsampled material, but this needs to be verified via QA

completeness checks, according to the lab's QAPP.) The "identified organisms" are those organisms within the subsample that are specifically identified and counted.

The original sample material shall be stored in 70 percent ethanol and retained by the discharger until: 1) all QA analyses specified herein and in the relevant QA plan are completed; and 2) any data corrections and/or re-analyses recommended by the external QA laboratory have been implemented. The remaining subsampled material shall be stored in 70 percent ethanol and retained until completeness checks have been performed according to the relevant QA plan. The identified organisms shall be stored in 70 percent ethanol, in separate glass vials for each of the five replicates for each site for each sample date. The discharger shall preserve and retain these identified organisms until the Regional Board's Executive Officer accepts in writing the fifth biennial monitoring report (i.e., If monitoring commences in 2009, and is conducted every other year, in 2011, 2013, 2015, and 2017, the identified organisms shall be preserved and retained by the discharger as described above until the ten-year report on the 2017 results is accepted in writing by the Executive Officer).

The external QA samples shall be stored in 70 percent ethanol in separate glass vials for each final ID taxon. (For example, a sample with 45 identified taxa would be archived in a minimum of 45 vials, each containing all individuals of the identified taxon.) Each of the vials containing identified organisms shall be labeled with taxonomic information (i.e., taxon name, organism count) and collection information (i.e., site name/site code, waterbody name, date collected, method of collection). These samples shall be transmitted to the external QA laboratory, and once returned by the external QA laboratory shall be archived (i.e., retained) by the discharger for the same duration as the other identified organisms.

All archived samples shall be checked at least once per year and "topped off" with ethanol to prevent desiccation, and shall be relinquished to the Water Board upon request by any Water Board staff.

9. ATTACHMENTS

1. *Appendix 1-7.pdf* from Herbst (2001), "Stream Form" (3 pages)

2. *D-50 calculation template.xls* (Excel spreadsheet template for calculating and reporting D-50 particle size and "percent fines plus sand")

3. *Squaw_permit_attachment_3_Calculator_for_Squaw_Cr_Biological_Targets.xls* (Example Excel spreadsheet template for calculating individual component metrics of the Biological Condition Score)

10. REFERENCES

Herbst, D.B. 2001. *Quality Assurance Project Plan – Aquatic invertebrate bioassessment monitoring in the Eastern Sierra Nevada*, Sierra Nevada Aquatic Research Laboratory and Lahontan Regional Water Quality Control Board. Download at: http://www.waterboards.ca.gov/lahontan/water_issues/projects/quality_assurance_project_plan/index.shtml

Herbst, D.B. 2002. *Development of Biological Water Quality Targets for Assessment of Total Maximum Daily Load (TMDL) of Sediment in the Squaw Creek Watershed (Placer County, California)*. Final Report to Lahontan Regional Water Quality Control Board for Contract #9-118-160-0. April 16, 2002. 39 pp. Download at: http://www.waterboards.ca.gov/lahontan/water_issues/programs/swamp/docs/herbst_scb_2002.pdf.

Herbst, D.B., and E.L. Silldorff. 2004. *Performance of Different Bioassessment Methods from California: Side-by-Side Comparisons of Field, Laboratory and Analysis Procedures for Streams of the Eastern Sierra Nevada*. Final Report to the Lahontan Regional Water Quality Control Board for Contract #9-191-160-0. November 26, 2004. 51 pp. Download at: http://www.waterboards.ca.gov/lahontan/water_issues/programs/swamp/docs/herbst_silldorff_methods_comparison_2004.pdf

Surface Water Ambient Monitoring Program (SWAMP). 2007. *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California.* California State Water Resources Control Board, Sacramento, CA. February 2007. 48pp. Download at: http://www.waterboards.ca.gov/swamp/docs/phab_sopr6.pdf