U. S. Geological Survey
Surface Water Branch
Portland, Oregon

THE OPERATION AND MAINTENANCE OF A CREST-STAGE GAGING STATION

October 1965

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By

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Prepared by the
U.S. Geological Survey
Surface Water Branch
Portland, Oregon

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PREFACE

A cooperative agreement between the Geological Survey and the Forest Service was initiated in 1965 when a network of crest-stage gaging stations was established in national forests in Oregon and Washington. This program is designed to be a continuing effort in which field data are collected by the Forest Service and furnished to the Geological Survey for computation of the peak discharge data and subsequent publication.

This manual is prepared as an aid to Forest Service field engineers who may not be familiar with various aspects of the program but are responsible for the collection of field data.

The manual covers the operation and maintenance of crest-stage gaging stations, but is limited in scope in that stream-gaging techniques and computation procedures are not included. The manual offers various guidelines that should be followed in the routine collection of basic data and is not intended as an official training manual of the Geological Survey.

This manual was prepared under the general supervision of R.B. Sanderson, district engineer in charge of surface water investigations in Oregon.

TABLE of CONTENTS

ILLUSTRATIONS

APPENDIX

INTRODUCTION

The purpose of this manual is to familiarize field personnel with the procedures involved in operating crest-stage gaging stations. Crest-stage gages are used to determine the elevation of a peak stage occurring at a specific location in a stream.

A crest-stage gage consists of a length of 1¼-inch diameter pipe installed in a vertical position in the stream channel (figure 1). The pipe is vented and equipped with an intake system that allows water to enter and leave the pipe as the stream rises and recedes. An equal length of aluminum "T" channel (staff) is inserted in the pipe and made to rest on a positive stop called a datum pin. When granulated cork is placed in the gage, the cork will float on the rising stage, then adhere to the staff after the stage recedes. The peak stage is then determined by removing the staff and measuring the distance between the cork line and the lower end of the staff.

The primary purpose of a crest-stage gaging station is to collect hydrologic data for flood-frequency analyses. Collection of data for such analyses involves operating a network of stations for a period of years until sufficient peak flow data are obtained to accurately define flood-frequency curves. Because carelessness in collecting data at the gage site might result in the loss of an entire year's flood event, the importance of proper operation and maintenance of these gages can not be overemphasized.

Peak discharges are related to the basin characteristics and major changes in these characteristics must be evaluated. Forest fires, timber harvest, or a new road location that alters the natural drainage of the basin, may effect the intensity and timing of the runoff of the basin.

INTRODUCTION (continued)

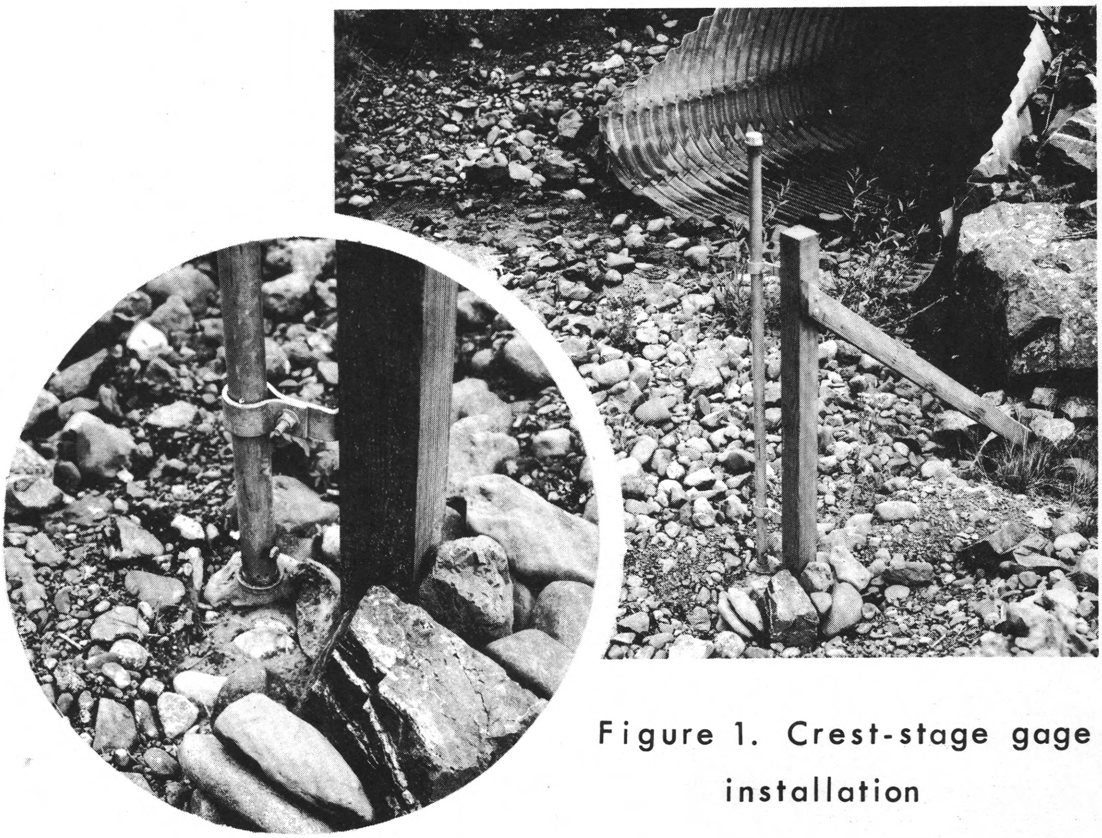


Figure 1. Crest-stage gage installation

Rigid datum controls must be maintained at the gage site throughout the period of record. Physical changes of the site resulting from flood flows or manmade alterations must be evaluated. If a drainage structure such as a culvert is part of the site features, free-flow conditions must be maintained or obstructions carefully documented.

LOCATION of GAGES

The accuracy of the peak data collected at a crest-stage gaging station depends in part on the stability of a stage-discharge relation developed at the site (appendix A). Culvert structures provide an excellent means for establishing a stable relationship (rating) if headwater and tailwater elevations are known. Small dams and bridge sites can sometimes be used with a good degree of reliability.

LOCATION of GAGES (continued)

The computation of flow through a culvert involves the evaluation of head losses from a point upstream from the culvert to a point where the energy control occurs within or downstream from the culvert (figure 2). Gages are therefore located at this upstream point which is referred to as an approach section. Because the gage records static head, it should not be placed near the drawdown area at the entrance to the culvert, or near pileup areas caused by headwalls, trees, or bank irregularities. Usually, a gage placed one culvert width upstream from the culvert entrance will avoid these problem areas.

Tailwater gages are installed whenever the downstream channel conditions may affect the flow within the culvert barrel. These gages are located near the culvert exit but away from the issuing jet from the barrel.

The number of gages needed at a site depends on the range-in-stage of the stream, and the alignment of the approach channel. A curving channel that superelevates the flow on one bank usually requires gages on both banks so that an average elevation can be determined.

OPERATION

The fieldwork required to operate a crest-stage station can be divided into two phases, periodic inspections and annual maintenance. Periodic inspections involve the reading and servicing of the gages throughout the year; annual maintenance involves surveying, replacing damaged gages, and otherwise documenting changes in the site geometry or basin morphology.

Periodic Inspections

The quality of peak data collected at a crest-stage station depends primarily on the attention given to the site by the field engineers during the year. Inspections should be made every 4 to 6 weeks throughout the flood season with special inspections made during or immediately after a flood event. If a site is inaccessible during the flood season, the quality of the data may be considered highly questionable.

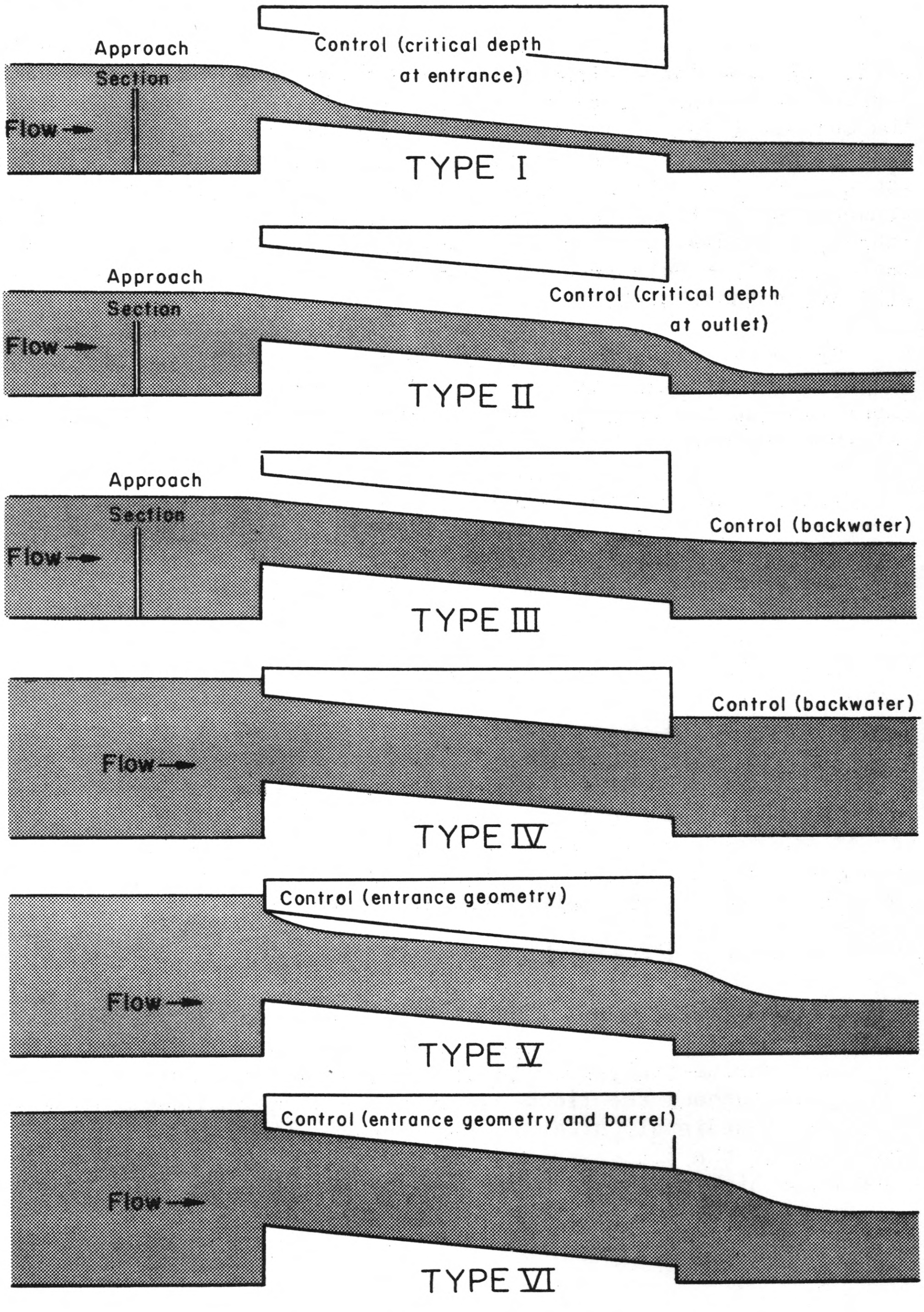


Figure 2. Classification of culvert flow.

Some engineers question the need for making repeated inspections when they are reasonably sure a peak event has not occurred. The reason frequent inspections are necessary is that personal observations are our only source of information when the peak data is analyzed. For example, a windfall in the channel may cause backwater at certain stages, a scoured road fill might have been repaired by a maintenance crew, a low road-overflow section might have been graded, or a gage intake may become obstructed by ice or silt. These conditions may occur at any time and must be considered in evaluating the reliability of the peak data.

Inspecting the gages at a crest-stage station is a matter of recording the data from a flood peak that might have occurred since the previous visit, and servicing the gages so that they will record the next peak. To aid in this work, a description for each station is prepared which gives all of the pertinent information concerning the station (appendix B).

Station descriptions

The station description gives the location of the site and a road log along the best access route to the site. If a site is isolated and a road log is impractical, a location map is prepared showing the best access roads from the nearest main roads or inhabited areas.

The location of each crest-stage gage, reference marks and, in some instances, permanent transit points are described. Elevations are given for the datum pins, the top of the gage pipes, and the reference mark(s).

A brief description of the present channel configuration is given as an aid in determining changes in roughness coefficients which may occur.

Much of the data given in the station descriptions are subject to change due to alterations or better definition of site properties. Because of this, the descriptions are updated annually.

OPERATION (continued)

Recording field data

The peak data are recorded on a special note form (Portland CS-11) which contains four principal headings; High-water Marks from Gages, Present Water Surface, Outside High-water Marks, and Remarks (appendix C).

HIGH-WATER MARKS FROM GAGES.--This section provides for the computation of a peak stage by entering the elevation of the datum pin of each gage (obtained from the station description) and adding the readings obtained by measuring the distance between the cork line and the bottom of the staff. The entries must be made in the appropriate columns which are headed Upstream and Downstream (with respect to the culvert), and Right Bank and Left Bank (as they appear while looking in the downstream direction). Some stations may have two or more gages on one bank because of a large range-in-stage. In such cases, qualify the gage location by entering a statement such as "low", "high", or "intermediate." This section also provides for entering precipitation data, if known.

The date the high water occurred is bracketed by the dates of the inspections and it should be recorded if known, otherwise this must be estimated on the basis of weather records, or from nearby continuous-record gaging stations.

PRESENT WATER SURFACE.--This section provides for the computation of the present stage of the stream by adding or subtracting the distance the water surface is above or below the datum pins at the time of the inspection. This information can also be obtained by measuring the distance between the top of the gage pipe (with the cap removed) and the water surface when stages are too high to safely use the datum pins as reference points. When measuring to a surging water surface, use the mean of the surge as the measuring point. For extremely low flows, it is not necessary to obtain a water surface reading at more than one gage above and below the culvert. The time of day should be noted as provided for on the note form.

The control is a term used to identify that feature of the site that is governing the stage-discharge relation at the approach section. During low flows, the control will usually be a riffle between the approach section and the culvert. It is very important to know at what stage the riffle becomes drowned out and the culvert begins to control the flow. A space is therefore provided to describe what is forming the control at the time of the inspection.

RECORDING FIELD DATA (continued)

OUTSIDE HIGH-WATER MARKS.--High-water marks on the stream banks in the vicinity of the gages should be located, flagged and tied in to the site datum whenever possible. These marks are used to verify the gage readings and to define the flood profile above and below the culvert. If the distances involved are small, a hand level or a string level can be used to tie in the marks. If distances are greater than 20 feet, surveying or leveling may be necessary. The marks should be preserved by flagging, stakes, or nails if a subsequent survey is involved because the quality of the marks deteriorates rapidly in a very short time. Describe the marks and their location in the appropriate box on the field note form.

REMARKS.--Enter any other information regarding the site in this box. Such information could include listing photographs that might have been taken, changes in the projection of the culvert entrance from the road fill, work to be done on a pending maintenance trip, or changes in the access route to the station.

OPERATION (continued)

Servicing procedure

The procedure involved in servicing crest-stage gages depends on the stage of the stream at the time of the inspection. If the stage is <u>below the datum pin</u>, the procedure should be as follows:

1. Remove the cap at the top of the gage pipe.

2. Remove the staff and if cork particles indicate a peak has occurred, mark the cork line with a pencil line, then remove all cork particles. If a cork line is found at the same elevation as the vent hole, the gage may have been topped. Always verify such a mark by outside high-water marks.

3. Enter the date of the inspection on the penciled line and measure the distance from the line to the bottom of the staff (to the nearest hundredth of a foot). The bottom of the staff is painted green to avoid confusion as to which end is the lower end.

4. Remove the lower cap and flush out any silt that might have collected, make sure all intake and vent holes are unobstructed.

5. Place one tablespoon of granulated cork in the bottom cap and secure the cap with a pipe wrench. Caps that are easily removed are often taken by children of all ages. Make sure the intake system is positioned so that the 5 closely-spaced holes face upstream.

6. Replace the top cap (with a wrench) and make sure all bracket bolts and lag screws are tight.

7. Determine the present water surface at the gages (to the nearest hundredth of a foot).

8. Remove debris that might have collected on the gage.

9. Carefully describe and measure any debris that might have collected at or within the culvert. Try to estimate the location of the debris at the time of the peak flow (floating, lodged in the entrance, etc.). Draw a diagram of the obstruction. Remove the debris and record any resultant change in the present water-surface elevation at the gage.

10. Document the outside high-water marks and any changes in channel and culvert properties. If a peak stage has not occurred since the previous visit, the cork supply in the gage may be adequate. Never assume the gage is fully charged because ants or wind will sometimes remove the cork.

If the present water-surface elevation is <u>higher than the datum pin</u>, and the stage is falling, the above procedure should be modified as follows:

1. Perform steps 1 to 3 as described.

2. Carefully pour a teaspoon of cork (half of the amount used when servicing the gage from the bottom cap) into the gage pipe. Wipe the staff completely dry and lower it very slowly into the pipe. If the staff is lowered too fast, an erroneous present water-surface reading will result due to the rapid displacement of water within the gage pipe. Make it a practice to determine the present water-surface elevation by measuring outside the pipe.

3. Perform steps 6 to 10 as described.

If the present water surface is <u>high and rising</u>, use the following procedure:

1. Remove the top cap.

2. Do not remove the staff from the gage. The removal of the staff may cause an erroneous mark if the stream is near its peak stage.

3. Determine the present water surface by measuring the distance between the top of the gage pipe and the water surface.

4. Indicate the rising trend of the stream on the note sheets along with the time of day.

SERVICING PROCEDURE (continued)

5. Replace the top cap and try to identify the control for the present flow (figure 2). For low-head flows the control may be the occurrence of critical depth at the entrance (Type I) or outlet of the culvert (Type II), or the channel below the culvert (Type III). For high-head flows, the entrance is submerged and the control could again be the downstream channel (Type IV), or the entrance geometry (Type V) or a combination of entrance geometry and the culvert barrel (Type VI).

6. Photograph flood flows whenever possible.

If the gages can not be reached because of high stages, flag the present water surface so that it can be tied into the gage datum at a later date. Record what you have done.

Annual Maintenance

Annual maintenance is usually done in late summer. The purpose of this work is to repair damaged gages and to document any change in site properties that might have resulted during the year from floodflows or manmade alterations. Gages may need replacing due to flood damage, raising to avoid silting of the intake, or lowering to better record low annual peaks. Whenever a gage is repositioned, it must be tied in to the datum established when the site was instrumented. This is done by differential leveling from a reference mark at the site. The instrument should be given a two-peg test prior to the survey to make sure it is in proper adjustment. Record this test in the survey notes.

Gage datum

This is an arbitrary datum, assumed at the time the site was surveyed, and maintained by establishing one or more permanent reference marks at the site. The reference marks are usually galvanized lag screws set near the base of a sturdy tree. The reference mark is fully described and the elevation is given in the station description. Mean sea-level datum is determined whenever possible by differential or barometric leveling to a nearby bench mark. In lieu of this, the altitude of the gage is determined from topographic maps.

Surveying

A transit survey of the site is made when the station is established. From this survey, a plan view of the site is drawn in which all site features are shown to scale (appendix D). Generally, it will not be necessary to resurvey a site unless an unusually high flood destroyed the gages (or the gages were overtopped) or considerable road overflow occurred.

Several methods of surveying are satisfactory for this work, but the preferred method is a transit-stadia survey. This method involves using azimuth, distance, and elevation readings. The azimuth is read to the nearest minute, stadia distances are computed to the nearest foot, and elevations (except cross-section elevations) are read to the nearest hundredth of a foot. Cross-section elevations are read to the nearest tenth of a foot.

The transit may be set up at any convenient location, oriented to magnetic north, and the described readings made. At some sites, it may be preferable to establish a permanent transit point from which a bearing line may be used to orient the instrument. If a permanent transit point has been established, the location and reference bearings are fully described in the station description. The procedures involved in making the survey are not rigid, but adequate explanation of what was done is essential.

GAGES.--Surveying gages is a matter of locating the gage with respect to the culvert, and determining the elevation of the datum pin and the top of the gage pipe (with the cap removed).

The addition of one new gage generally would not require a complete survey. Tape-measured distances to two or more site features along with careful leveling to the gage is usually adequate.

CROSS SECTIONS.--The initial survey of the site involves relating cross sections to the alignment of the approach channel and the culvert. Cross sections are established at the gage(s) in the approach channel and along the crown of the road (or whatever part of the road fill is highest) if road overflow is likely to occur.

SURVEYING (continued)

The ends of the cross section in the channel are established by setting hubs on each bank at an elevation higher than the water surface when the stream depth is equal to one and a half culvert diameters. If the hubs are destroyed, the cross section may be reoriented by positioning the section normal to the direction of flow in the approach channel (not necessarily normal to the axis of the culvert barrel). The location of the cross section is always at the gage(s). Sometimes a cross section is broken so that it may better intercept the direction of flow entering the main channel from wide bank overflow areas above the culvert. This break is called a dog leg and is usually established by breaking the section 45 degrees and extending it directly to the road fill. (See appendix D.)

The cross section is defined by stretching a cloth or steel tape between the hubs and taking elevation readings at sharp changes in the contour of the channel. Each reading is related to the tape stationing with the initial point located on the left bank of the channel. Be sure to indicate the tape stationing at the gage(s) in the cross section.

Road overflow sections are usually wide, shallow, areas that may have scoured during peak flows. Considerable judgement must be used to determine what point would best represent the depth of the water flowing over the road. Grading operations and heavy vehicular traffic constantly change the profile of a dirt road and therefore can cause a serious question as to the extent of road overflow.

CULVERT.--Surveying the culvert requires two operations. The first operation ties in the location and elevations of the invert at both ends of the culvert, the second measures the length of the barrel and the geometry of the culvert entrance.

The invert elevations are used to determine the slope of the culvert and, if an invert is irregular due to the presence of channel bed material, readings should be taken at each side of the bed material as well as at the centerline of the culvert. Elevations should be determined at the toe and at the point of full opening of a mitered-end culvert.

The entrance geometry is extremely important in computing peak flow. The cross-sectional area of the culvert barrel must be carefully measured and if the entrance becomes deformed by debris, the deformity must be measured. Always obtain horizontal and vertical diameter measurements. The distance a corrugated metal pipe projects from a road fill must be measured at several points around the circumference of the barrel. These horizontal measurements indicate the reentrant conditions of the entrance and they should be checked at frequent intervals. If a culvert roof is bent inward at some point within the barrel, the location and extent of indentation must be recorded.

This discussion has been directed toward corrugated pipe and pipe-arch installations. Concrete-box installations with wing-walls require additional measurements of wingwall angles, fillets, bevel or rounding of the entrance edge, and noting the condition of the concrete finish (smooth, rough, etc.).

Leveling

Differential leveling is used to maintain a constant datum control at the site. This is an annual operation in which the gages and cross sections are checked for possible changes in elevation that might have occurred during the year.

GAGES.--Leveling to the datum pins of the gages requires either a closed-circuit or a double-rodded level line. A closed-circuit line involves using the datum pin of each gage as a turning point in the circuit. The error of closure at the permanent reference mark should be less than 0.02 foot. A double-rodded line requires the repositioning of the instrument after the first series of readings has been made. Some level surveys may require a combination of these two methods. The elevation of the datum pin of a gage should not be changed unless it is found to be more than 0.03 foot in error.

CROSS SECTIONS.--Checking cross sections for changes resulting from scour or fill is a matter of recovering the hubs that have been set at the ends of the section, and determining channel elevations as described earlier in this manual (see page 12). If the hubs have been destroyed, some site feature must be related to the stationing of the section so that the cross section can be related to previous surveys. Such features may be the gages in the approach channel or the culvert axis.

LEVELING (continued)

CULVERT.--The annual check made on the culvert is to determine any change that might have occurred in the amount, size, and location of bed material on the invert. Otherwise, a clean invert would not require check leveling more often than once every 3 years. The amount of culvert projection from the road fill must be measured as previously explained. (See page 12.)

Miscellaneous

The work performed during annual maintenance is the primary source of information used for updating the station descriptions. Changes in access roads, gages, reference marks, or channel roughness must be noted.

At this time, gage intakes and vent holes are cleaned, pipe threads greased, and brush is removed from the culvert and approach sections. Trails must be maintained to assure safe access to the gages during the year. Photographs of the gages, approach section, and culvert should be taken if possible.

SPECIAL PROVISIONS and ACCESSORIES

Various modifications may be made in the instrumentation described in this manual. Staff gages may be installed on the gage support for easier determination of the present water surface, or the gages may be numbered and referred to by number rather than as a left or right bank gage. If a number system is used, the gage must be equipped with a permanent, easily seen, number at the site. Assignment of a number to a gage must be fully explained in the field notes when the assignment is made.

Some engineers may prefer to graduate the aluminum staff for direct reading of cork line elevations.

There should be no locking device attached to the caps of a crest-stage gage unless a key is provided to Geological Survey personnel. Securing these fittings with a pipe wrench is usually adequate security against vandalism.

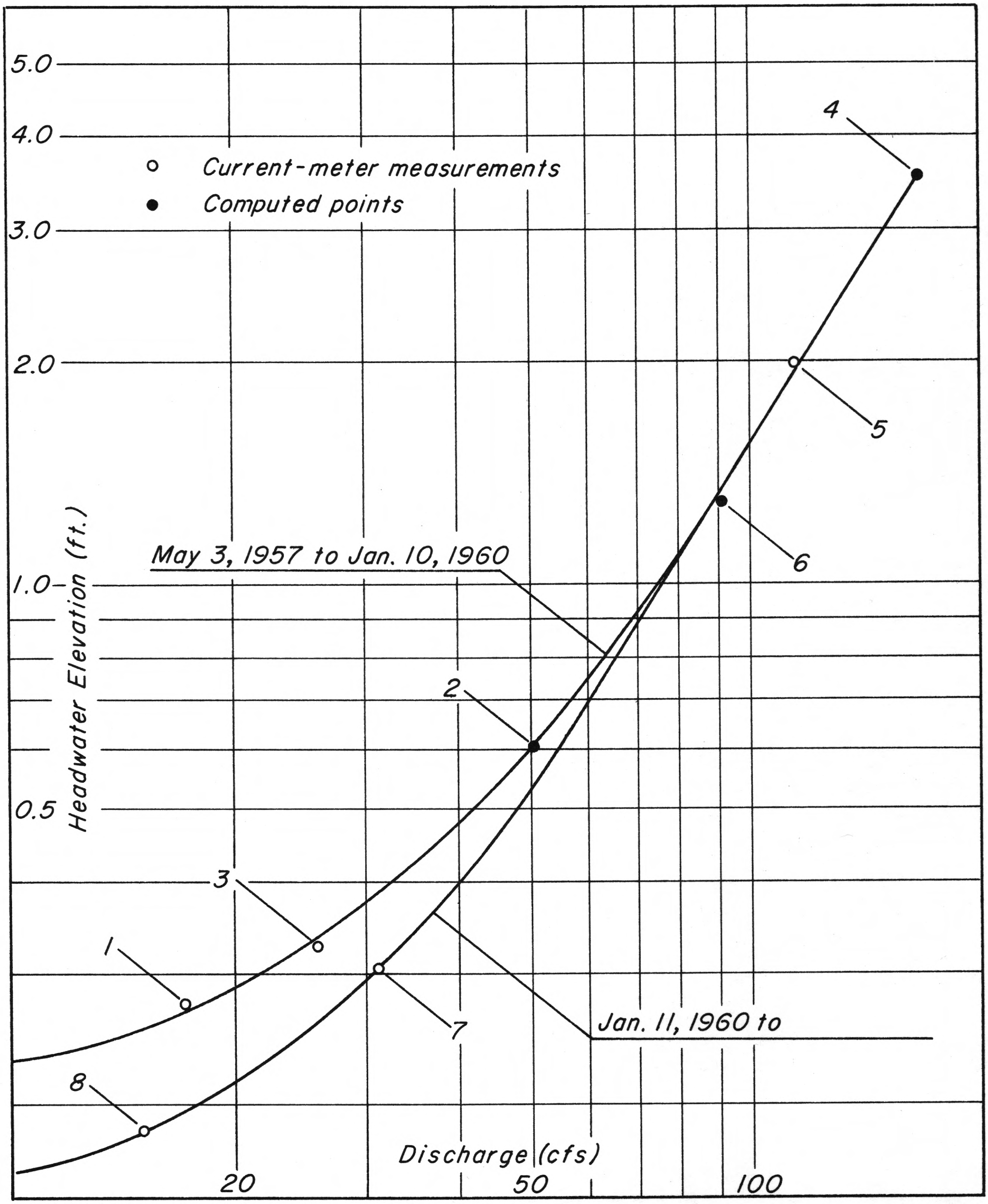
DATA TRANSMITTAL

Inspection and survey notes should be transmitted to the Portland district office of the Geological Survey as soon as possible. Many times a lag in transmitting these data results in a duplication of effort in the field. If additional information is needed regarding a particular inspection, it is most easily obtained from the field engineer if the inspection trip is fresh in his mind. The mailing address for data transmittals is:

U. S. Geological Survey
Water Resources Division
P. O. Box 3087
Portland, Oregon 97208

REPORTS

The Geological Survey will publish a compilation of peak data soon after the close of each water year (September 30). Provisional data will be made available on special request during the year providing the stage-discharge relation for the site has been adequately defined.


5.0
4.0
3.0
2.0
1.0
0.5
Headwater Elevation (ft.)
Current-meter measurements
Computed points
May 3, 1957 to Jan. 10, 1960
Jan. 11, 1960 to
1
2
3
4
5
6
7
8
Discharge (cfs)
20
50
100

Appendix A

File No. { Washington ______
Field 14-0321

Description Prepared 10-14-63 (Date)
by J. Friday

Description of Gaging Station on Butter Creek near Pine City, Oreg.

1. Location.--Station in NW¼ sec.23, T.2 N., R.27 E., at culvert on State Highway 207, 4.2 miles north of Pine City.
Road log:
At junction of State Highway 207 and U.S. Highway 30, proceed south on 207.

	Mileage	Difference
1. Junction	0.0	0.0
2. County road, continue on 207	6.0	6.0
3. Crest-stage site	11.5	5.5

2. Drainage area.--1.50 sq mi. Measured on Umatilla, 1:125000 quadrangle.
3. Establishment.--Aug. 10, 1963 by J. Friday and P. Jeffs.
4. Gage.--Three 5-ft crest-stage gages mounted on posts at a 7-ft diameter culvert. Elevations of pins of gages are as follows:
   L.B. upstream gage, 8.43 ft.
   R.B. upstream gage, 9.70 ft.
   L.B. downstream gage, 6.07 ft.
   Elevation of top of gage pipes (with caps removed) are as follows:
   L.B. upstream gage, 13.45 ft.
   R.B. upstream gage, 14.68 ft.
   L.B. downstream gage, 11.10 ft.
5. Reference mark.--R.M.1 is 3/8" lag screw (painted yellow) set in telephone pole on left bank, 50 feet south of culvert. Elevation, 17.51 ft.
6. Channel.--Upstream channel approaches culvert in sweeping curve. Downstream channel provides good getaway. Channel consists of soft earth material and is very unstable.
7. Stereo pictures.--No's 910 to 914.
8. Cooperation.--In cooperation with the State of Oregon through the State Highway Commission.

Appendix B

PORTLAND
CS-10
1959

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

INSPECTION OF CREST-STAGE GAGE

Stream Granite Creek near Dale, Oreg.
Party John Friday Date Jan. 3 1965

HIGH WATER MARKS FROM GAGES

PRECIPITATION 0.8 inch rain gage at site	UPSTREAM		DOWNSTREAM	
	RIGHT BANK	LEFT BANK	RIGHT BANK	LEFT BANK
PIN ELEVATIONS	14.87	14.11		11.03
READING (+)	2.71	3.49		3.67
H.W.M. ELEVATIONS	17.58	17.60		14.70

DATE OF HIGH WATER Jan. 2, 1965

PRESENT WATER SURFACE

TIME 0830 Pst.	UPSTREAM		DOWNSTREAM	
	RIGHT BANK	LEFT BANK	RIGHT BANK	LEFT BANK
(PIN OR TOP OF GAGE PIPE) ELEVATIONS	14.87	14.11		11.03
READING (±)	- 0.21	+ 0.51		- 0.72
P.W.S. ELEVATIONS	14.66	14.62		10.31

CONTROL Riffle 5 ft below approach, deposited during Jan. 2 peak, will probably scour out again.

OUTSIDE HIGH WATER MARKS

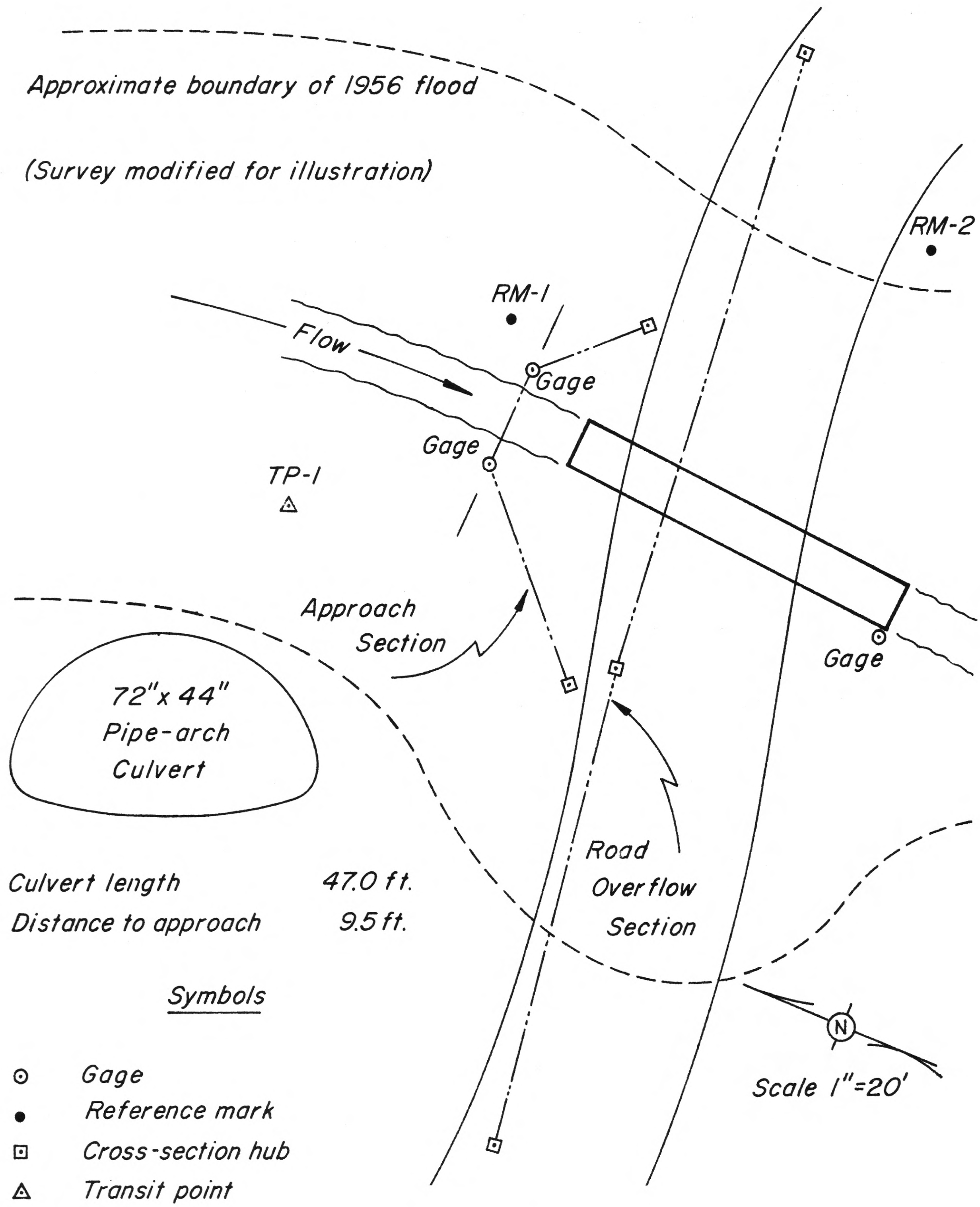
Flagged 4 good debris lines on banks at approach section, 2 fair marks at tailwater gage. Hand level survey made.
(USE BACK OF SHEET IF NECESSARY)

REMARKS

Culvert clear of debris. Recharged all gages. No change in culvert projection.
(USE BACK OF SHEET IF NECESSARY)

MEASURE FROM BOTTOM OF STAFF TO ELEVATION OF LINE OR LINES OF CLINGING PARTICLES. RECORD THIS DISTANCE AS "READING". MARK THE STAFF WITH THE DATE OF INSPECTION AND A HORIZONTAL LINE, THEN CLEAN THE ENTIRE STAFF. LEAVE THE GAGE IN CONDITION TO RECORD ANY RISE OF STREAM WITHIN ITS RANGE OF USE.

Appendix C


Approximate boundary of 1956 flood
(Survey modified for illustration)
RM-2
RM-1
Flow
Gage
Gage
TP-1
Approach
Section
Gage
72"x 44"
Pipe-arch
Culvert
Road
Overflow
Section
Culvert length 47.0 ft.
Distance to approach 9.5 ft.
Symbols
Gage
Reference mark
Cross-section hub
Transit point
N
Scale 1"=20'

Appendix D

GLOSSARY of TERMS

Approach section.--A term used to identify the location of gages established upstream from a drainage structure for the purpose of determining energy-head losses in the channel. For some conditions of flow, a stage-discharge relation is developed at this point.

Control.--Designates a feature downstream from a gage that controls the stage-discharge relation at the gage. The control will usually occur where there is a contraction of flow within or downstream from a drainage structure.

Cross section.--A series of points defining the shape of the channel (or road overflow) on a line normal to the direction of flow.

Cubic foot-per second.--The rate of discharge of a stream whose channel is 1 square foot in cross-sectional area and whose average velocity is 1 foot per second.

Datum pin.--A small horizontal pin, set at the base of a crest-stage gage, for which an elevation is known and used as a reference point for determining peak stages.

Discharge, Flow, (Q).--An expression of an instantaneous volume of water flowing past a specific point in the stream channel.

Gage datum.--An arbitrary datum established for the purpose of relating elevations of various site features to a common vertical control.

Gage height, Stage (Ght.).--A term used in referring to the elevation of the water surface of the stream. The numerical value is always related to gage datum.

Range-in-stage.--The difference in elevation between the highest and lowest peak stages experienced in a stream.

Reference mark.--A permanent monument established at a site from which a datum control can be maintained.

Staff.--An aluminum rod placed in a crest-stage gage for the purpose of measuring the distance a peak stage exceeded the elevation of the datum pin.

Staff gage.--A graduated scale installed in a stream channel for the purpose of making present water surface readings.