GUIDE FOR SUBSURFACE INVESTIGATIONS IN IOWA STRUCTURES, POOLS, TANKS, DRAINS

This guide outlines investigations needed to determine construction required at a specific site. It is to be used to provide a basis for judgments on normal sites and to help identify sites where the judgment of specialists is needed to assist with the field work or to develop the plan for foundation investigation. For most sites the problems encountered are sand pockets or strata, high water table, shallow bedrock or sinkholes, and pipable soils. Investigation of dam sites to determine water retention will normally indicate the problem areas and types of treatment required for earth dams. Sites for borrow need to be identified and volumes estimated before construction. Investigation of drainage measures to determine ease of excavation and spreading of spoil will normally indicate the problem areas and types of treatment required for the drainage measures.

Some site investigation may be a part of procedures of SCS or other agencies. For example, Part 407, Title 450, General Manual (450-GM) requires recording of soil boring logs for agricultural waste storage facilities. Test holes or test pits should be logged on Form SCS-ENG-533 using Unified Soil Classification System symbols. The Iowa Department of Natural Resources requirements for sealing holding ponds depend upon depth to bedrock and description of soil type and character. Other practices and other agencies may require additional investigation.

The investigations are part of ensuring that the practice functions through its planned life with the expected maintenance. The designer must know both the expected site conditions and the dependability of the methods used for investigation. Many times the conditions will be shown on the drawings to explain or control construction. Form IA-ENG-39 may be used by the investigator of the site. The documentation will be a part of the design file.

A geologist must make a preliminary site investigation of all structure sites in Iowa Engineering Job Class V through VIII. The intensity of investigation needed for Job Class I through IV structure sites can be determined by persons having job approval authority for the structure under consideration. SCS policy for subsurface investigations of structure sites is contained in Part 531, NEM.

Typical subsurface investigations include:

I. Structures with permanent water storage

A. Iowa Engineering Job Class IV or V with drainage areas of less than 80 acres.

(1) One hole near the low point along the centerline of the earth fill. Investigate to a depth equal to one-half the maximum height of earth fill.

(2) One hole near the control section of the vegetated spillway. Investigate to a depth of one foot lower than the control section elevation on the outside edge of the spillway.

(3) One hole in the pool to determine depth of borrow, if any. Investigate to a depth of 5 feet lower than any borrow excavation.

(4) Holes in the borrow area as needed to locate one and one-half times the needed volume of fill.

B. Iowa Engineering Job Class IV or V with drainage areas of 80 to 250 acres:

(1) Three holes along the centerline of the earth fill to include:

(a) One hole on each abutment near the elevation of the proposed pool. Investigate to a depth of 5 feet.

(b) One hole near the low point of the section. Investigate to a depth equal to one-half the maximum height of earth fill.

(2) One hole near the control section of the emergency spillway. Investigate to a depth of one foot lower than the control section elevation at the outside edge of the spillway.

(3) One hole in the bottom of the pool for each acre of normal pool area. Investigate each hole to a depth of five feet lower than any borrow excavation.

(4) Holes in the borrow area as needed to locate one and one-half times the needed volume of fill.

II. Structures without permanent water storage should receive the same degree of investigation as structures with permanent water storage (above) except for items IA(3) and IB(3). Test holes are probably unnecessary for these structures since the holes are primarily to determine water holding capacity of the permanent pool area.

III. Dugout Pond

One hole per half-acre of surface area at normal pool elevation. Investigate to a depth of 2 feet below the bottom of the dugout.

(EFM, Amend. IA29, July 1986)

IV. Agricultural Waste Storage Facility, SCS Standard and Specification 313. Where a high water table or highly permeable material such as sand and gravel or fractured limestone is suspected near or above the level of the floor, at least one soil boring shall be made at the side of the tank. This boring shall be drilled to a minimum depth of 5 feet below the bottom of the floor. The log of the boring showing each strata of material, the water surface, and the date of observation, shall be shown on the plan.

V. Holding Ponds, SCS Standard and Specification 425

A. Investigate to a depth of five feet below the bottom of the floor. One hole per one-half acre of surface area at maximum storage.

B. Investigate to a depth of ten feet below the bottom of the floor if either of the following conditions exist:

(1) Vertical excavation required for construction of the runoff storage basin exceeds 15 feet below natural topography at the site.

(2) Soil survey information or personal knowledge and experience at the site area indicates possibility that the vertical separation distance between the basin floor and fractured rock or limestone is less than ten (10) feet.

VI. Drainage Mains and Laterals or Drainage Field Ditches

A. No holes are required for ditches with less than one square mile drainage area if soil surveys or personal knowledge and experience in the site area indicate no bedrock or saturated sands at the site.

B. Holes shall be excavated as directed by the engineer for ditches draining one square mile or more and ditches including the probability of excavating bedrock or saturated sands.

VII. Subsurface Drains

A. No holes are required if soil surveys or personal knowledge and experience at the site indicate no bedrock or sands within two feet of the drain.

B. Holes shall be bored as directed by an engineer at locations where bedrock or sands may be within two feet of the drain.

C. A drain installed to outlet terraces, diversions or basins may be installed through short reaches of rock on steep slopes. Such an outlet may be designed by a technician experienced in such construction without borings or direction from an engineer.

(EFM, Amend. IA29, July 1986)

DISCUSSION

Each hole to be investigated leads to some decision on construction such as location of the centerline, depth of a core trench, location of a vegetated spillway, location of borrow areas, side slopes of an excavation, sealing of a pool or perhaps selection of drain materials. Soil maps with interpretations are most valuable in showing possible problems, if any, and selecting the most productive holes for investigation.

At pond sites water holding ability may be indicated by performance of nearby ponds, particularly if built at about the same elevation in similar soil types. Willow trees or other water tolerant vegetation indicates water holding ability at some sites. Seepage flows normally outcrop at a barrier. Fewer holes may be needed if soil surveys or personal knowledge and experience show that onsite adjustments can be made during construction. Some holes are always needed if site investigation shows a possibility of expensive construction such as excavation of bedrock or a change in design concept such as a pipe structure without an emergency spillway when an emergency spillway is normally planned. Some holes may be needed because an appropriately qualified technician may not be available to make onsite adjustments during construction. Some holes may be needed to allow absentee landowners to agree to borrow sites.

Holes may be needed to allow estimates of volume at sites where borrow location is a problem. If limits of borrow are not needed before construction, borings in the borrow area aren't needed. Borrow volumes of less than 2500 cubic yards may need only a general location statement. Borrow volumes of more than 5000 cubic yards may require both a location to be shown on a drawing and an estimate of volume.

The planned depth of each hole may change during the investigation. For instance, to plan to borrow five feet and leave cover of 5 feet on a pool bottom, one would plan to investigate to a depth of 10 feet. Discovery of bedrock at less than 10 feet would end the investigation and change the depth of borrow.

At another pool site the pool is not planned to be investigated since bedrock is expected. The core trench investigation discloses a continuous blanket of shale which might allow borrow in the pool. Some investigation in the pool to check continuity and depth of shale could be added.

At another site additional investigation may require another trip to the site while final drawings are being prepared. For instance, excavation for a part of a practice may be 2 or 3 feet deeper than the investigation at a site where bedrock is expected. If adjustment during construction would not be possible, additional investigation would be needed before completion of final drawings.

A full profile of holes should be shown on the drawings to aid in construction. One example is the drawing on Page 5-15 of the Engineering

Field Manual. On pond sites with drainage areas of less than 30 acres and fill heights less than 20 feet, the logs of the holes need not be shown on the drawings but may be kept with the design file. The soils should be classified with the Unified Soil Classification System but the USDA textural classification may also be used. Sometimes color changes may be the most useful part of the log.

Pages IA4-32(6 through 11) supplement information and figures already in the Engineering Field Manual and give guidance on field classification of soils.

A worksheet (Form IA-ENG-39) is provided to guide and record the extent of the investigation. The foundation investigation must be recorded but not necessarily on the worksheet.

The end result of appropriate investigation should be the construction of a practice to meet its purpose without major changes in location or cost during construction. Making the investigations and communicating the data to ensure the end result is everyone's responsibility. An investigation that meets this intent meets the Guide.

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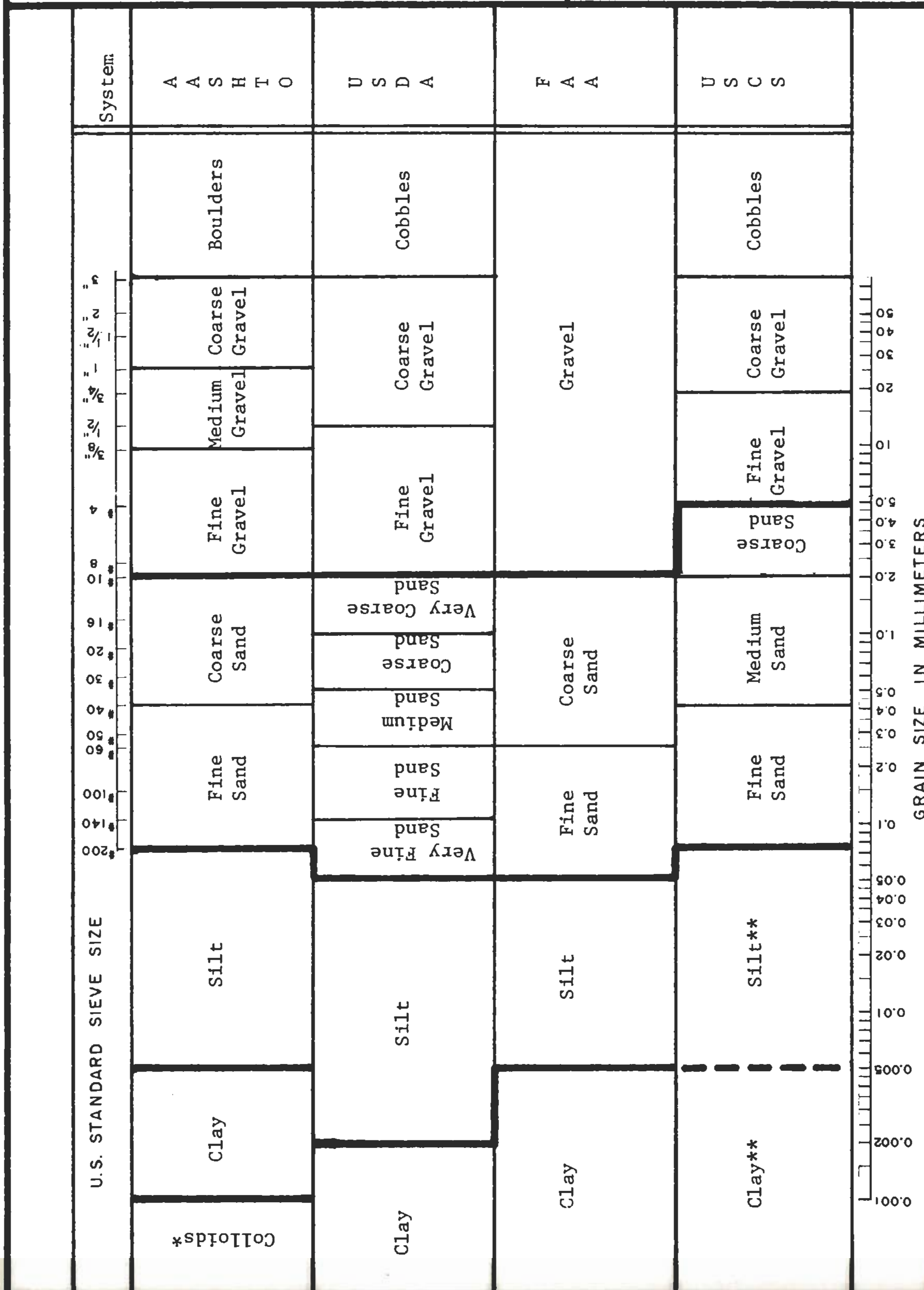
PARTICLE SIZES



* Colloids included in clay fraction in test reports.
** The LL and PI of "Silt" plot below the "A"-line on the Plasticity Chart and the LL and PI of "Clay" plot above the "A"-line, or in the hatched zone.

(EFM, Amend. IA29, July 1986)

UNIFIED SOIL CLASSIFICATION

FIELD IDENTIFICATION
FIELD IDENTIFICATION PROCEDURES

ABBREVIATIONS

The abbreviation for a soil group in the Unified Soil Classification System consists of two or more letters. Each letter has a particular meaning, which is helpful in the shorthand description of the soil. Each of the letters used in the system and its meaning is summarized below:

G - Gravel - denotes a soil with less than 50 percent fines containing more gravel than sand.

S - Sand - denotes a soil with less than 50 percent fines containing more sand than gravel.

P - Poorly graded - denotes a sand or gravel with 12% or less fines content that is poorly graded.

W - Well-graded - denotes a sand or gravel with 12% or less fines content that is well-graded.

H - High liquid limit - modifier used for fine-grained soils to denote liquid limit values of 50 or higher.

L - Low liquid limit - modifier used for fine-grained soils to denote liquid limit of less than 50.

C - Plastic Fines - modifier used to describe plasticity characteristics of fine-grained soils or coarse-grained soils with significant content of fines. Denotes fines with plastic characteristics.

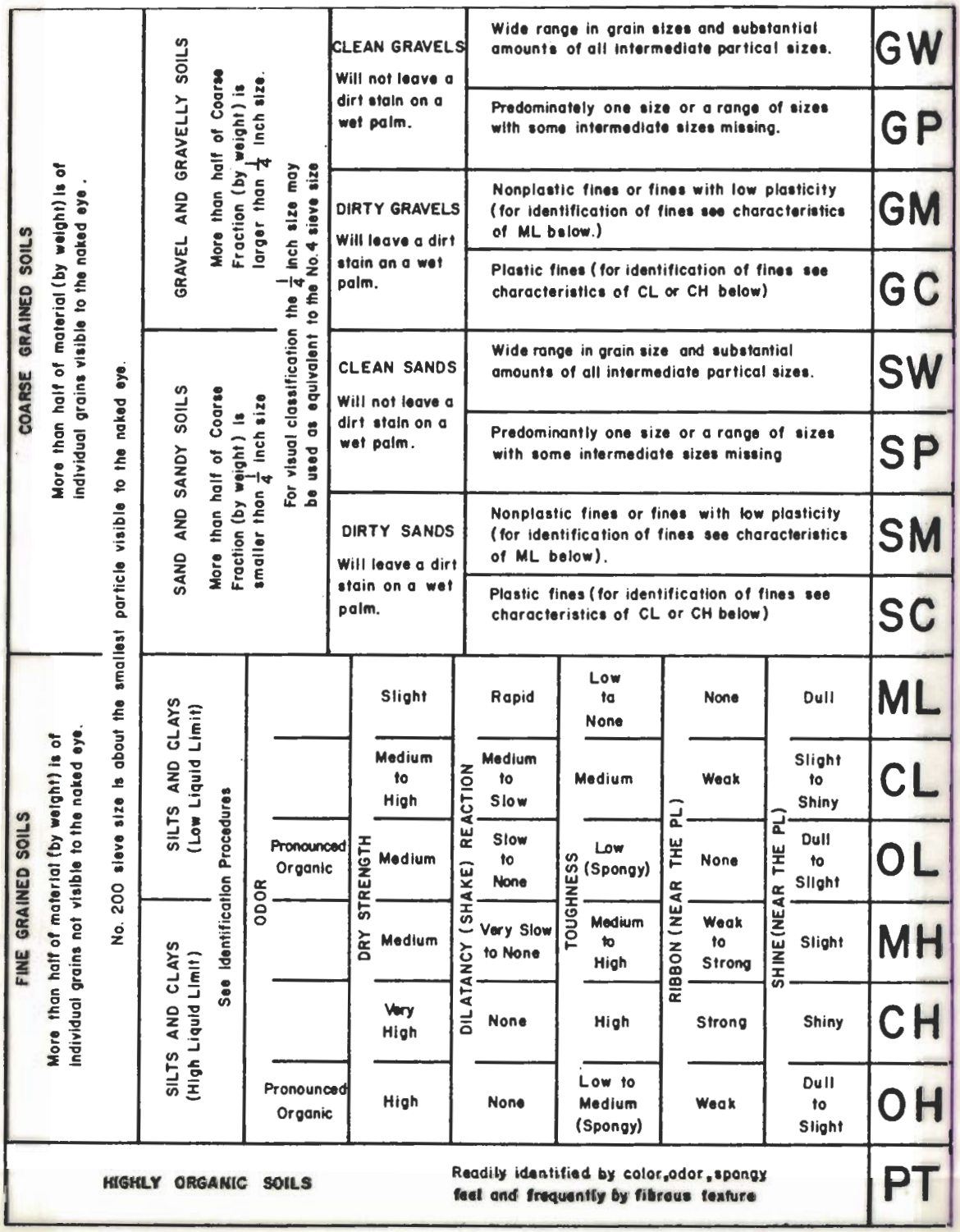
M - Non-plastic to Slightly Plastic - modifier used to describe plasticity characteristics of fine-grained soils or coarse-grained soils with significant content of fines. Denotes fines with non-plastic to slightly plastic characteristics.

O - Organic modifier used to describe fine-grained soils with organic characteristics.

Pt - Peat - symbol for peat in the Unified Soil Classification System.

By combining these symbols, group names are derived. For example, a GP soil is a poorly graded gravel. A CH soil is a plastic soil with a high liquid limit. A GC soil is a gravel with plastic fines..

FLOW CHART
UNIFIED SOIL CLASSIFICATION
FIELD IDENTIFICATION
FIELD IDENTIFICATION PROCEDURES



(EFM, Amend. IA29, July 1986)

GUIDE FOR ESTIMATING USDA TEXTURAL CLASSES

USDA TEXTURE CLASS	CONSISTENCE			OTHER TESTS EVALUATED AT A WET CONSISTENCE			
	DRY	WET		MOLDED BALL	RIBBONING[1]	GRITTINESS	SMOOTHNESS[2]
		STICKINESS	PLASTICITY				
SAND	Loose	Nonsticky	Nonplastic	None	None	Very Gritty	---
LOAMY SAND	Soft	Nonsticky	Nonplastic	Very Weak	None	Very Gritty	---
SANDY LOAM	Soft[3] to slightly hard	Nonsticky to slightly sticky	Nonplastic to slightly plastic	Very Weak to fragile	Slight	Gritty	---
SANDY CLAY LOAM	Slightly hard to hard	Sticky	Plastic	Strong	Medium	Gritty	---
SANDY CLAY	Hard to very hard	Very sticky	Very plastic	Very strong	High	Gritty	---
LOAM	Slightly hard to soft	Slightly sticky to nonsticky	Slightly plastic to nonplastic	Strong to fragile	Slight to none	Somewhat gritty	Somewhat smooth
CLAY LOAM	Hard	Sticky	Plastic	Strong	Medium	Somewhat gritty	Somewhat smooth to smooth
SILT LOAM	Slightly hard to soft	Slightly sticky to nonsticky	Slightly plastic to nonplastic	Strong	Slight	None	Very smooth to smooth
SILT	Soft to slightly hard	Nonsticky	Nonplastic	Fragile to very weak	Slight	None	Very smooth
SILTY CLAY LOAM	Hard	Sticky	Plastic	Strong	Medium	None	Very smooth
SILTY CLAY	Very hard	Very sticky	Very plastic	Very strong	High	None	Very smooth
CLAY	Very hard to extremely hard	Very sticky	Very plastic	Very strong	High	None	Smooth to very smooth

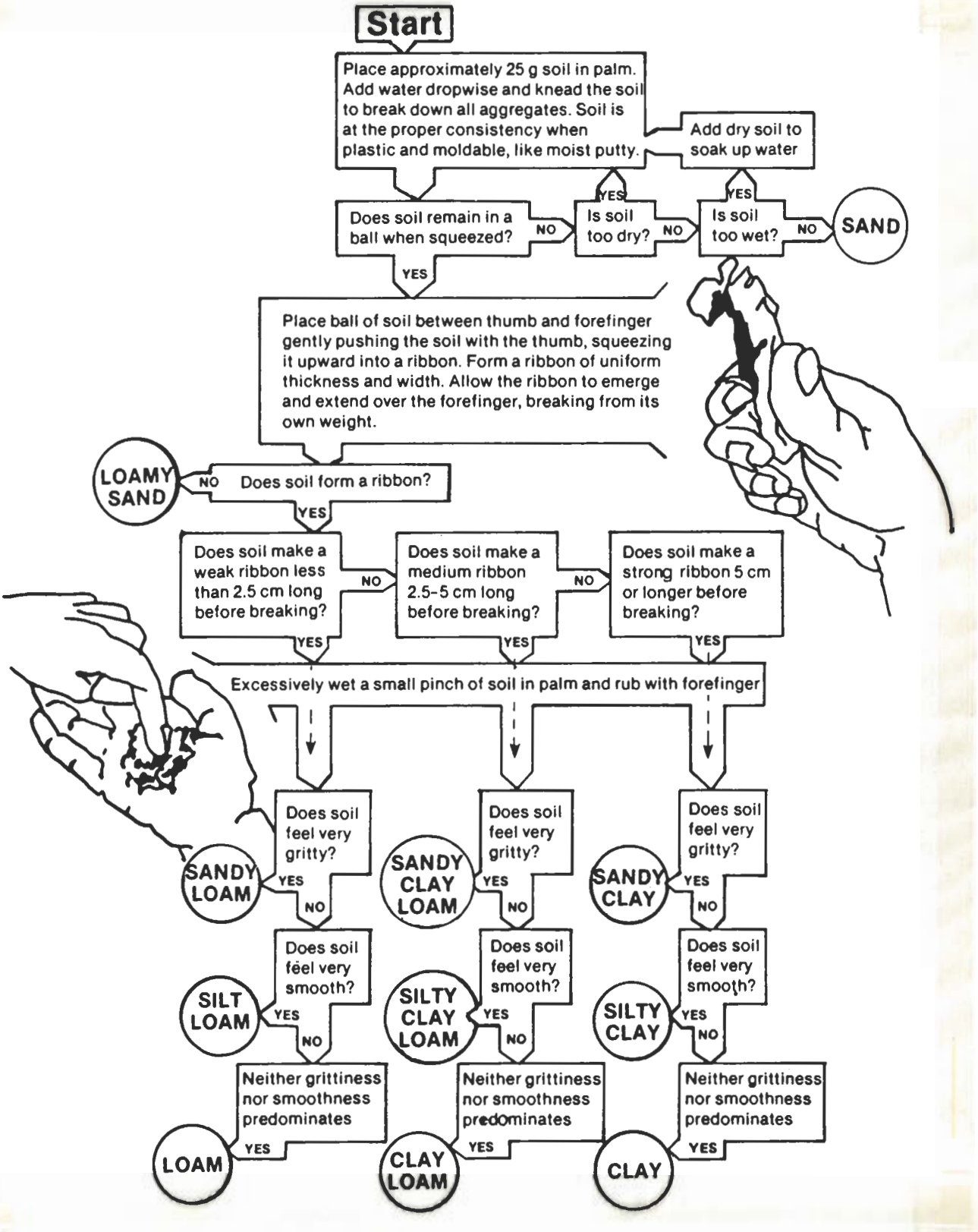
[1] Length of ribbon guidelines are based on experience with soils containing significant amounts of montmorillonite clay. These guidelines should be adjusted locally to account for any difference in mineralogy. For instance, ribboning guidelines for soils having clays that are predominantly kaolinitic should be scaled downward.

[2] Smoothness is not evaluated for the textural classes of sand, loamy sand, sandy loam, sandy clay loam, and sandy clay because of their sand content.

[3] The descriptive term listed first is generally the reaction most often observed.

(EFM, Amend. IA29, July 1986)

FLOW DIAGRAM FOR ESTIMATING SOIL TEXTURE BY FEEL

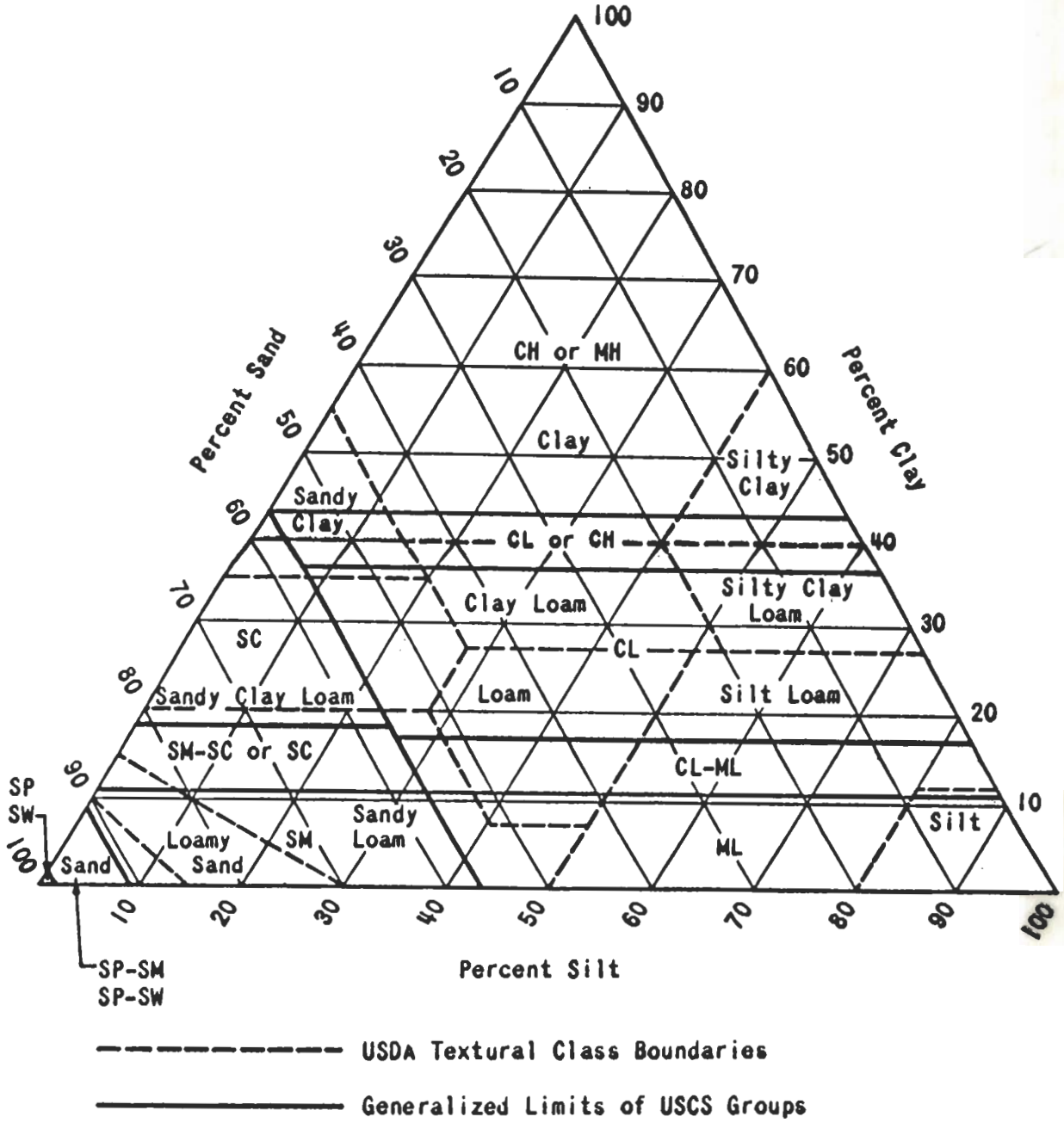


(EFM, Amend. IA29, July 1986)

GENERALIZED RELATIONSHIPS

Between

USCS and USDA



The above figure provides, Generalized Relationships Between Unified Soil Classification System Groups and USDA Textural Classes.

(EFM, Amend. IA29, July 1986)