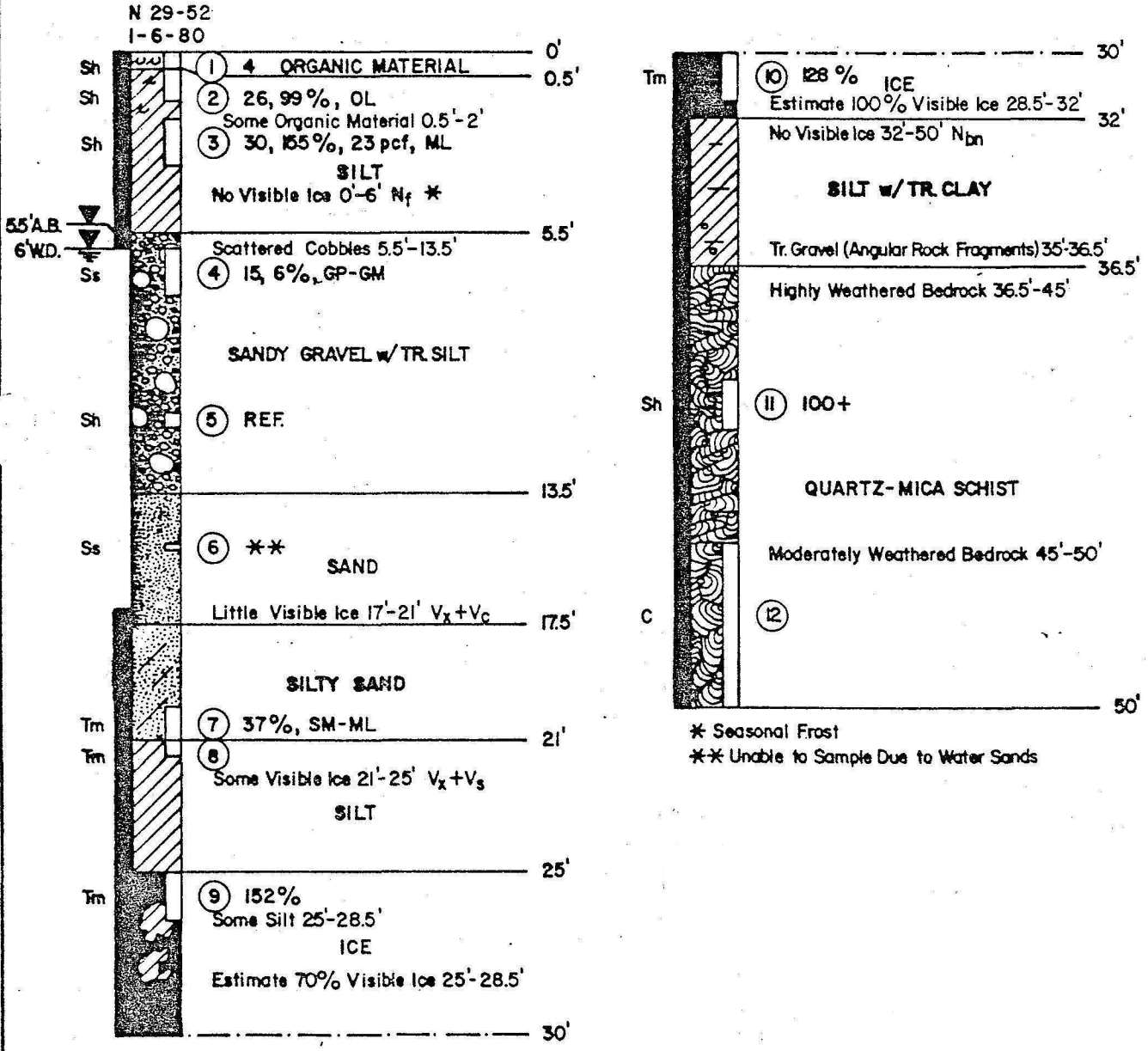
NORTHWEST ALASKAN PIPELINE COMPANY

BOREHOLE NO.
N 29-52
A.S. 088

EXAMPLE



* Seasonal Frost
** Unable to Sample Due to Water Sands

173-A

FLUOR 19821101-2

PREPARED BY
R&M CONSULTANTS, INC.

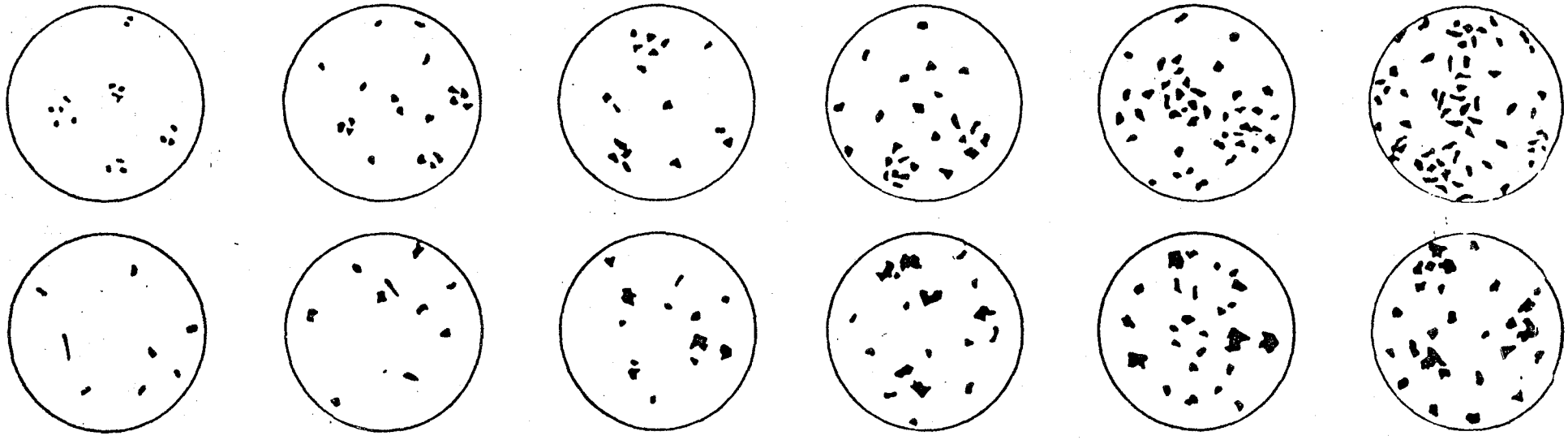
EXHIBIT 2

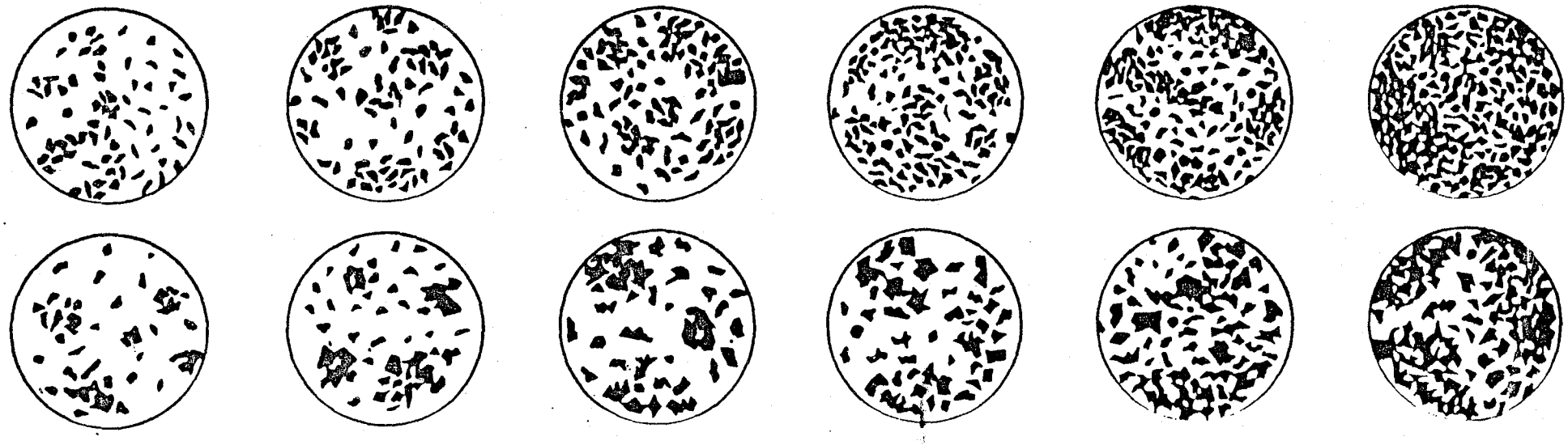
SAMPLING METHOD CODE

Sampler Method	Computer Code	Sample Code
Small Hand Collected Sample	01	Ch
Hand Collected Bulk Sample	02	Ch
6 in. Becker Rev. Circ. Plug Core or Frags	03	F
3 in. Becker Rev. Circ. Plug Core or Frags	04	F
1.4 Split Spoon with 47 lb. Hammer	05	Sb
1.4 Split Spoon with 140 lb. Hammer	06	Ss
1.4 Split Spoon with 340 lb. Hammer	07	Sz
2.5 Split Spoon with 140 lb. Hammer	08	Sl
2.5 Split Spoon with 340 lb. Hammer	09	Sh
4.0 Split Spoon with 340 lb. Hammer	30	Sx
2.5 Split Spoon Pushed	10	Sp
4.0 Split Spoon Pushed	29	Sm
1.4 Split Spoon with Air Hammer	11	Sa
2.5 Split Spoon with Air Hammer	12	Sa
Shelby Tube, 2 in. O.D.	13	Ts
Shelby Tube, 2.5 in. O.D.	14	Ts
Shelby Tube, 3.0 in. O.D.	15	Ts
Pitcher Barrel, 2.5 in. O.D.	16	Pb
Pitcher Barrel, 3.0 in. O.D.	17	Pb
3.0 in. CRREL Core Barrel	18	Cc
2.5 in. Single Tube Core Barrel	19	Cs
3.0 in. Single Tube Core Barrel	20	Cs
"E-Size" Double Tube Core Barrel	21	Cd
"A-Size" Double Tube Core Barrel	22	Cd
"B-Size" Double Tube Core Barrel	23	Cd
"N-Size" Double Tube Core Barrel	24	Cd
"H-Size" Double Tube Core Barrel	25	Cd
"3.0" Double Tube Core Barrel	26	Cd
Modified Shelby Tube 2.5" I.D.	27	Tm
Modified Shelby Tube 4.0" O.D.	28	Tm
Auger Sample	31	A
Bucket Auger Sample	32	B
Cuttings	33	C

Note: If the exact size of sampler is not indicated by one of the standard codes use the nearest code plus an asterisk and make a conspicuous note in the narrative section of the log.

VOLUMETRI[illegible]STIMATION CHART





SOIL SYMBOLS


ORGANIC MATERIAL


CLAY


SILT


SAND


GRAVEL


COBBLES & BOULDERS


ROCK FRAGMENT


BEDROCK


ICE CRYSTALS


ICE LENS


ICE, MASSIVE


ORGANIC SILT


CLAY w/SOME GRAVEL, TR. SILT


SILT (ESTIMATE 45% ICE LENSES)


SILT w/SOME ORGANIC MATERIAL


SILT w/SOME CLAY


SANDY SILT


SAND (4" ICE LENS AT 20')


SAND w/SOME SILT, TR. GRAVEL


SAND w/SOME SILT, SCATTERED COBBLES & BOULDERS


SANDY GRAVEL


ICE w/TR. SILT

IT SHOULD BE NOTED THAT ANY COMBINATION OF SYMBOLS IS USABLE EVEN THOUGH IT IS NOT SPECIFICALLY SHOWN IN THE ABOVE ILLUSTRATIO

*Please see the attached sheets for clarification of modifications to be used on the Northwest Alaskan Pipeline Project.

EXHIBIT - 5

Unified Soil Classification

(Including Identification and Description)

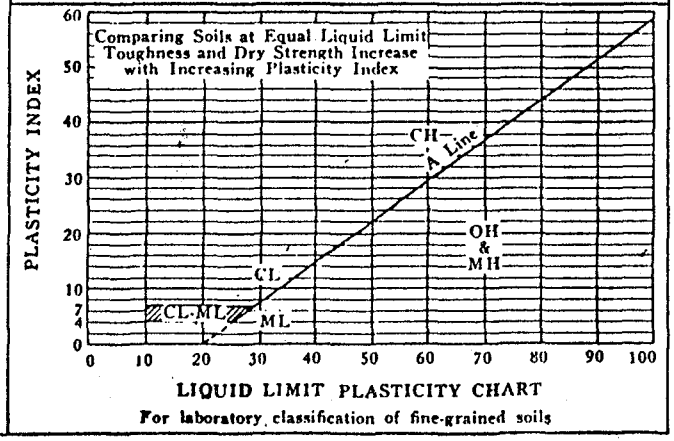
Major Divisions			Group Symbols	Typical Names	Field Identification Procedures (Excluding particles larger than 3 inches and basing fractions on estimated weights)			Information Required for Describing Soils
1	2		3	4	5			6
Coarse-grained Soils: More than half of material is larger than No. 200 sieve size. The No. 200 sieve size is about the smallest particle visible to the naked eye.	Gravels: More than half of coarse fraction is larger than No. 4 sieve size. (For visual classification, the ¼-in. size may be used as equivalent to the No. 4 sieve size)	Clean Gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.			For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.			
		Gravels with Fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	Nonplastic fines or fines with low plasticity. (for identification procedures see ML below)			Give typical name; indicate approximate percentages of sand and gravel, max. size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.
			GC	Clayey gravels, gravel-sand-clay mixtures.	Plastic fines (for identification procedures see CL below).			
	Sands: More than half of coarse fraction is smaller than No. 4 sieve size.	Clean Sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.			
			SP	Poorly-graded sands, gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.			Example: Silty sand, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).
		Sands with Fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity. (for identification procedures see ML below)			
			SC	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).			
Fine-grained Soils: More than half of material is smaller than No. 200 sieve size.	Silts and Clays: Liquid limit less than 50				Identification Procedures on Fraction Smaller than No. 40 Sieve Size			
					Dry Strength (Crushing characteristics)	Dilatancy (Reaction to shaking)	Toughness (Consistency near PL)	
			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high	None to very slow	Medium	
			OL	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight	For undisturbed soils and information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.
	Silts and Clays: Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to medium	
			CH	Inorganic clays of high plasticity, fat clays.	High to very high	None	High	
			OH	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium	Example: Clayey silt, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (ML).
Highly Organic Soils			Pt	Peat and other highly organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			

(1) Boundary classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder. (2) All sieve sizes on this chart are U.S. standard.

Unified Soil Classification

Laboratory Classification Criteria		
7		
Determine percentages of gravel and sand from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse-grained soils are classified as follows: Less than 5% — GW, GP, SW, SP. More than 12% — GM, GC, SM, SC. 5% to 12% — Borderline cases requiring use of dual symbols.	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 4 $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3	(See note, far right)
	Not meeting all gradation requirements for GW	
	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
	Atterberg limits above "A" line with PI greater than 7	
	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 6 $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3	(See note, far right)
	Not meeting all gradation requirements for SW	
	Atterberg limits below "A" line or PI less than 4	Limits plotting in hatched zone with PI between 4 and 7 are borderline cases requiring use of dual symbols.
	Atterberg limits above "A" line with PI greater than 7	

Use grain-size curve in identifying the fractions as given under field identification.



PLASTICITY CHART

For laboratory classification of fine-grained soils

FIELD IDENTIFICATION PROCEDURES FOR FINE-GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking)

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics)

After removing particles larger than No. 40 sieve size, mold a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit)

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size is molded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays wihch occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

Note
(Laboratory Classification)

Cu = uniformity coefficient

Cc = coefficient of curvature

D_{60} = grain diameter at 60% passing

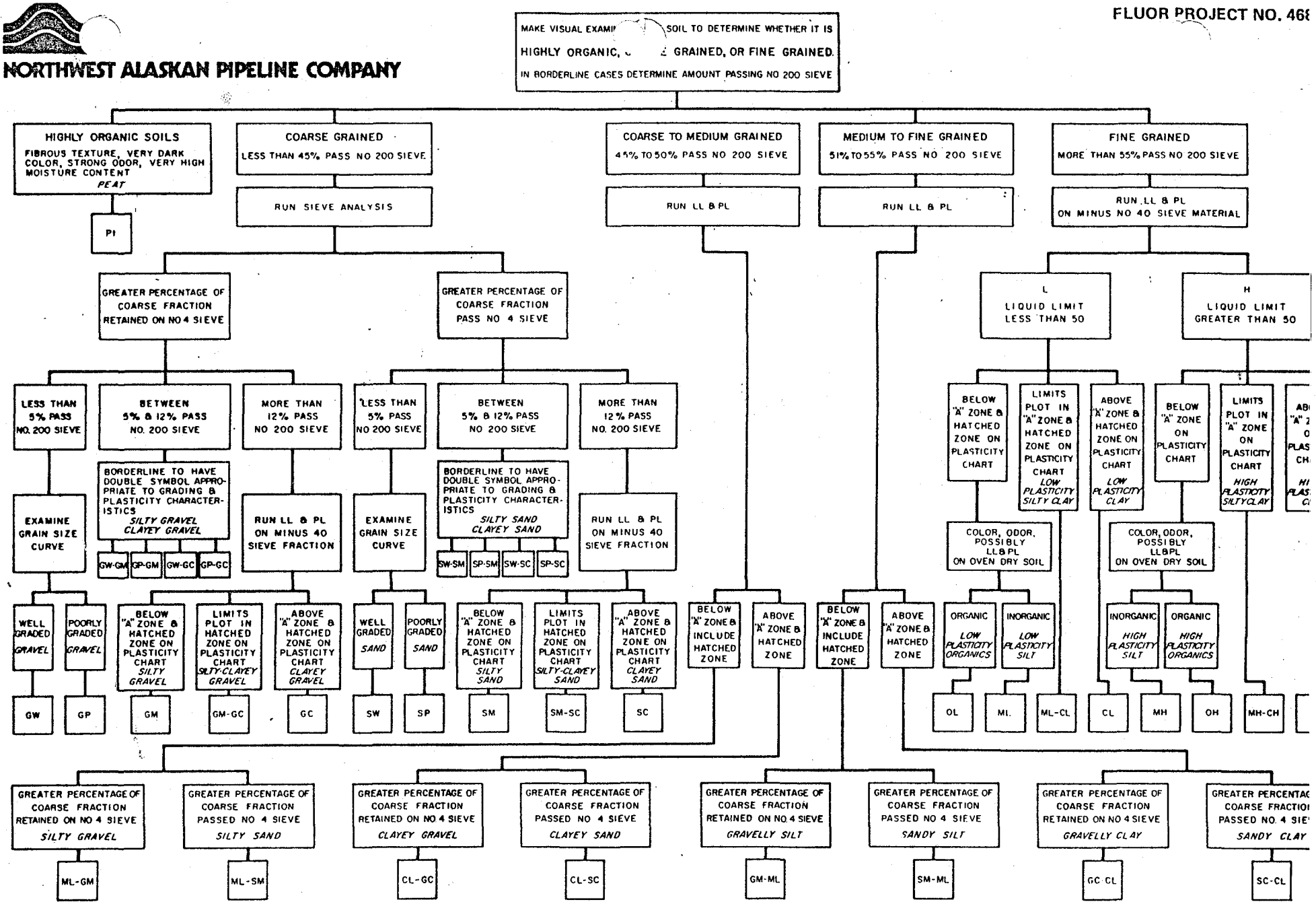
D_{30} = grain diameter at 30% passing

D_{10} = grain diameter at 10% passing

The grain-size distributions of well-graded materials generally plot as smooth and regular concave curves with no sizes lacking or no excess of material in any size range. The uniformity coefficient (Cu) of well-graded gravels is greater than 4, and of well-graded sands is greater than 6.

The coefficient of curvature (Cc) insures that the grading curve will have a concave curvature within relatively narrow limits for a given D_{60} and D_{10} combination. All gradations not meeting the foregoing criteria are classed as poorly graded.

NORTHWEST ALASKAN PIPELINE COMPANY

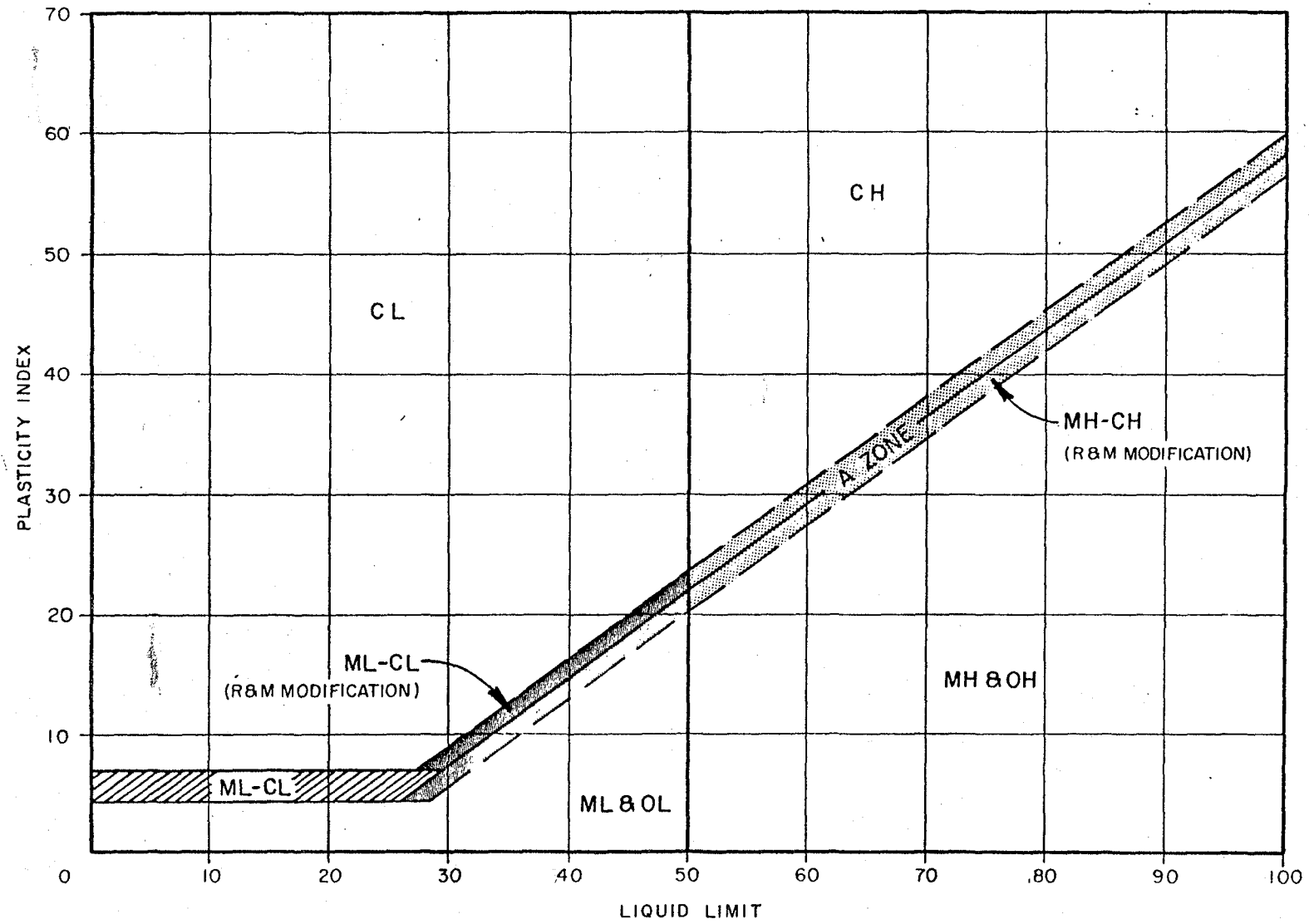


UNIFIED SOIL CLASSIFICATION SYSTEM (MODIFIED

R&M CONSULTANTS, INC.

NORTHWEST ALASKAN PIPELINE COMPANY

FLUOR PR(NO. 468084



PLASTICITY CHART (MODIFIED)

R&M CONSULTANTS, INC.

FIELD LOG NOMENCLATURE

ICE DESCRIPTION-FROZEN SOILS*

ICE NOT VISIBLE
Poorly Bonded or Friable (Nf)
Well Bonded, No Excess Ice (Nbn)
Well Bonded, Excess Ice (Nbe)
ICE VISIBLE, <1" Thick
Crystals – (Vx)
Ice Coatings on Particles – (Vc)
Random or Irregularly
Oriented Ice Formations – (Vr)
Stratified Or Distinctly
Oriented Ice Formations – (Vs)
ICE VISIBLE, >1" Thick
Ice with Soil Inclusions – (Ice + Soil Type)
Ice without Soil Inclusions – (Ice)

*Specify either seasonal frost or permafrost

DENSITY - NON FROZEN

SOILS WITH CONSIDERABLE COHESION

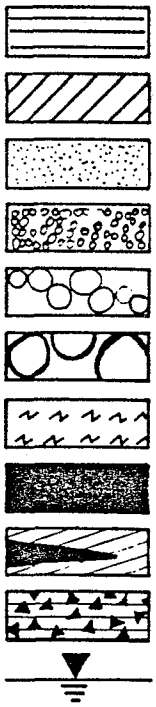
( )	Hard	– Difficult to indent
( )	Stiff	– Readily indented
( )	Firm	– Penetrated by mod. pressure
(S)	Soft	– Pentrated easily – can be remolded w/light finger pressure

COHESIONLESS SOILS

(L)	Loose	0 – 10 BPF
(MD)	Med. Dense	10 – 30 BPF
(D)	Dense	30 – 60 BPF
(VD)	Very Dense	>60 BPF

GRAPHIC SYMBOLS

(The symbols are frequently used in combinations, eg. silty clay.)



Clay (CL)	–.002 mm, High PI
Silt (St)	–#200, +.002mm
Sand (Sd)	–#4, +#200
Gravel (Gvl)	–3", +#4
Cobbles (Cbl)	–12", + 3"
Boulders (Bldr)	>12"
Organic (org)	
Ice (Show soil inclusions if appropriate)	
Ice Lens in Silt	
Ice Crystals in Clay	
Water Level (WD or AB – specify date)	

SOIL CALL OUT

Major Soil Names	>30%
Modifier "With"	>30%
Modifier "With Some"	13 – 30%
Modifier "With Trace"	4 – 12%
No Call Out	<4%

SAMPLE TOOL CODE*

A	Auger Sample
B	Bucket Auger Sample
C	Cuttings
Ch	Channel or other hand collected sample
Cc	CRREL Core Barrel
Cd	Double Tube Core Barrel**
Cs	Single Tube Core Barrel**
Pb	Pitcher Barrel**
	Split Spoon with Air Hammer**
	1.4 In. Split Spoon with 47 lb. Hammer
Ss	1.4 In. Split Spoon with 140 lb. Hammer
*	If sampling is done with a method not covered by a symbol, use an asterisk and a note.
Sz	1.4 In. Split Spoon with 340 lb. Hammer
Sl	2.5 Split Spoon with 140 lb. Hammer
Sh	2.5 Split Spoon with 340 lb. Hammer
Sp	2.5 Split Spoon Pushed
Sx	4.0 Split Spoon with 340 lb. Hammer
Sm	4.0 Split Spoon Pushed
Ts	Shelby Tube**
Tm	Modified Shelby Tube**
**	Use a note to give the sample ID in inches.

MOISTURE CONTENT

Very Wet (VW)	40%
Wet (W)	30 – 40
Very Moist (VM)	20 – 30
Moist (M)	15 – 20
Slightly Moist (SM)	10 – 15
Dry (D)	10%