OFFICE MEMORANDUM

DATE:

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Coarse Aggregate: Arthur #2 Pit No. 72-5, (Testing Laboratory Sample No. 75 A-912). Research Report No. R-1083.

On June 12, 1975, a sample of natural gravel coarse aggregate was received by the Department's Testing Laboratory. Information accompanying the sample stated that the material was obtained from the Arthur #2 Pit No. 72-5, location northwest of southwest, Section 3, T23N, R3W, Roscommon County. The material was submitted to the laboratory to be tested for information. Petrographic analysis of a portion of the sample was requested by G. H. Gallup.

Summary

Rock Class	Condition of Particles	Percent of Sample
Igneous	Hard, slightly to highly weathered, and non-porous to slightly porous on weathered surfaces	15
Metamorphic	Hard to moderately hard, slightly weathered and non-porous	24
Sedimentary	Hard to moderately hard, slightly to highly weathered, and non-porous to porous	61

Detailed tabulations of petrographic composition, specific gravity, and absorption are included in Tables 1 and 2.

Detailed Petrography

Petrographic examination was conducted in general conformance with ASTM C 295, "Petrographic Examination of Aggregates for Concrete." Representative portions--300 particles (see exception in Table 1)--of each sieve fraction of the sample were identified megascopically, along with acid testing, staining, and a scratch test for

hardness, and microscopically with a stereomicroscope. Specific gravity and absorption determinations were performed in general accordance with ASTM C 127, "Specific Gravity and Absorption of Coarse Aggregate." Determinations included all material analyzed. The following pages contain the rock type descriptions.

TESTING AND RESEARCH DIVISION

R. W. Muethel

Geologist - Materials Research Unit

TABLE 1
PETROGRAPHIC COMPOSITION
Testing Laboratory Sample No. 75 A-912

Rock Type	Sieve Fraction Analyzed				Computed Sample Composition
	1 to 3/4-in.	3/4 to 1/2-in.	1/2 to 3/8-in.	3/8 to No. 4	
Granite	6.0	9.7	10.0	7.7	8.4
Diorite	1.6	0.3	1.0	0.3	0.8
Gabbro	3.3	2.3	2.7	1.3	2.4
Basalt	1.1	2.3	1.7	4.0	2.3
Felsite	2.2	0.7	0.7	2.0	1.4
Quartzite	20.1	12.0	12.3	12.3	14.2
Metasediments	8.7	8.3	5.7	3.7	6.6
Tillite	3.3	1.7	2.7	4.3	3.0
Limestone	12.0	17.0	19.3	22.4	17.6
Argillaceous Limestone	2.7	2.3	0.3	0.7	1.5
Cherty Limestone	8.7	5.3	4.3	3.0	5.3
Dolomitic Limestone	1.1	0.7	--	0.7	0.6
Dolomite	14.1	15.0	12.7	11.7	13.3
Argillaceous Dolomite	1.1	0.7	0.3	0.3	0.6
Cherty Dolomite	4.3	2.7	4.3	2.0	3.3
Sandstone	0.5	0.7	1.3	1.3	1.0
Clay Ironstone	--	0.3	--	--	0.1
Chert	9.2	18.0	20.7	22.3	17.6
Totals, percent	100.0	100.0	100.0	100.0	100.0

Note: Computed sample composition is based upon counts of 300 particles contained in each of the sieve fractions noted excepting 1 to 3/4-in. (184 particles).

TABLE 2
SPECIFIC GRAVITY AND ABSORPTION DATA
Testing Laboratory Sample No. 75 A-912

Rock Type	Specific Gravity			Absorption, percent	Composition, Percent by Weight
	Bulk, dry	Bulk, ssd	Apparent		
Granite	2.64	2.65	2.67	0.38	8.5
Diorite	2.79	2.80	2.83	0.56	1.0
Gabbro	2.90	2.92	2.95	0.54	3.0
Basalt	2.89	2.90	2.92	0.29	1.9
Felsite	2.61	2.63	2.66	0.76	1.4
Quartzite	2.63	2.64	2.65	0.30	16.5
Metasediments	2.67	2.68	2.69	0.30	7.8
Tillite	2.72	2.72	2.73	0.24	3.0
Limestone	2.65	2.66	2.69	0.60	15.7
Argillaceous Limestone	2.47	2.54	2.65	2.71	1.9
Cherty Limestone	2.58	2.61	2.66	1.45	6.7
Dolomitic Limestone	2.59	2.64	2.73	2.01	1.0
Dolomite	2.72	2.75	2.81	1.19	14.7
Argillaceous Dolomite	2.49	2.59	2.79	4.33	0.7
Cherty Dolomite	2.60	2.65	2.73	1.92	3.7
Sandstone	2.14	2.29	2.52	7.07	0.7
Clay Ironstone	2.42	2.67	3.22	10.34	0.1
Chert	2.39	2.48	2.62	3.60	11.7
Total Sample	2.62	2.65	2.70	1.17	100.0

Note: Values are computed from determinations made on all sample material contained in the categories noted.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled pink to red, buff to white, and dark green to black; and mottled buff to white and black	mottled white and dark gray or green to black	mottled buff to white, gray to dark green or black, and yellowish brown; and mottled gray and black
Texture	medium to fine grained	medium to very fine grained	medium to fine grained
Luster	dull to subvitreous	dull	dull
Hardness	Mohs 7 to 6	Mohs 7 to 6	Mohs 5-1/2 to 6
Porosity	non-porous	non-porous	non-porous
Particle Shape	subrounded to rounded	subangular to subrounded	subrounded
Particle Surface	slightly weathered, rough to moderately smooth, dented	slightly weathered, rough to moderately smooth, dented	slightly to moderately weathered, rough to moderately smooth, dented to pitted

Rock Type	Basalt	Felsite
Color	dark green or gray to black; and mottled reddish to yellowish brown, and green to black	buff; gray; and mottled buff and gray to pink
Texture	fine grained to micro-crystalline	fine grained to micro-crystalline
Luster	dull	dull
Hardness	Mohs 5-1/2 to 6	Mohs 7 to 6
Porosity	non-porous to slightly porous on weathered surfaces	non-porous
Particle Shape	subangular to subrounded	subangular to subrounded
Particle Surface	slightly to moderately weathered, rough to smooth, dented	slightly weathered, rough to smooth, dented to pitted

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Tillite
Color	white; buff; pink to red or purple; gray to green; and mottled white or buff and gray to green	medium to dark gray or green; and mottled gray and buff to pink	medium gray to green
Texture	medium to very fine grained	very fine grained to micro-crystalline	microcrystalline groundmass with a porphyritic appearance
Luster	vitreous to dull	dull	dull
Hardness	Mohs 7	Mohs 4 to 7	Mohs 5 to 7
Porosity	non-porous	non-porous	non-porous
Particle Shape	subangular to rounded	subangular to rounded	subangular to rounded
Particle Surface	slightly weathered, rough to smooth, dented	slightly weathered, rough to smooth, dented	slightly weathered, rough to smooth, dented
Remarks		Some particles display traces of bedding or lenses.	

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous Limestone	Cherty Limestone
Color	grayish brown; buff; and mottled buff and gray	buff; and mottled buff to yellowish brown and gray	mottled buff to white and gray to grayish brown
Texture	fine grained to microcrystalline	fine grained to microcrystalline	fine grained to microcrystalline
Luster	dull	dull to earthy	dull
Hardness	Mohs 3	Mohs 3	Mohs 3 to 7
Porosity	non-porous to slightly porous	non-porous to finely porous	non-porous to finely porous
Particle Shape	subrounded to rounded	subrounded to rounded	subangular to subrounded
Particle Surface	slightly to moderately weathered, rough to smooth, dented	slightly to deeply weathered, rough to smooth, dented to pitted	slightly to moderately weathered, rough to smooth, dented to pitted
Remarks	A number of particles are fossiliferous.	Argillaceous material is disseminated or exposed in lenses or weathered pits.	Chert is exposed as disseminated material, nodules, or siliceous fossil fragments.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomitic Limestone	Dolomite	Argillaceous Dolomite
Color	buff	buff; gray; and mottled buff and gray	buff
Texture	fine grained to microcrystalline	fine grained to microcrystalline	very fine grained to microcrystalline
Luster	dull	dull	dull to earthy
Hardness	Mohs 3 to 4	Mohs 3-1/2 to 4	Mohs 3-1/2 to 4
Porosity	slightly porous	non-porous to slightly porous	finely porous
Particle Shape	rounded	subangular to rounded	subangular to rounded
Particle Surface	slightly weathered, moderately smooth	slightly weathered, moderately smooth to smooth, dented to pitted	slightly to moderately weathered, smooth, dented
Remarks		A number of particles contain small solution cavities.	

SEDIMENTARY ROCKS (Cont.)

Rock Type	Cherty Dolomite	Sandstone	Clay Ironstone
Color	buff; and mottled buff and gray to white	buff; and reddish to yellowish brown	yellowish brown
Texture	fine grained to microcrystalline	fine to very fine grained	microcrystalline
Luster	dull	dull	dull to earthy
Hardness	Mohs 4 to 7	Mohs 7	Mohs 4
Porosity	non-porous to slightly porous	porous to slightly porous	finely porous
Particle Shape	subrounded to rounded	rounded	subrounded
Particle Surface	slightly to moderately weathered, rough to smooth, dented	slightly to moderately weathered, rough	slightly weathered, smooth
Remarks	Chert is exposed as disseminated material or as nodules or seams.	One particle is friable.	One particle displaying concentric laminations was contained in this sample.

Rock Type	Chert
Color	buff; white; gray; yellowish brown; and mottled buff and white, gray, or yellowish brown
Texture	very fine grained to microcrystalline
Luster	dull
Hardness	Mohs 7
Porosity	finely porous to non-porous
Particle Shape	subangular to subrounded
Particle Surface	slightly to highly weathered, rough to smooth, dented