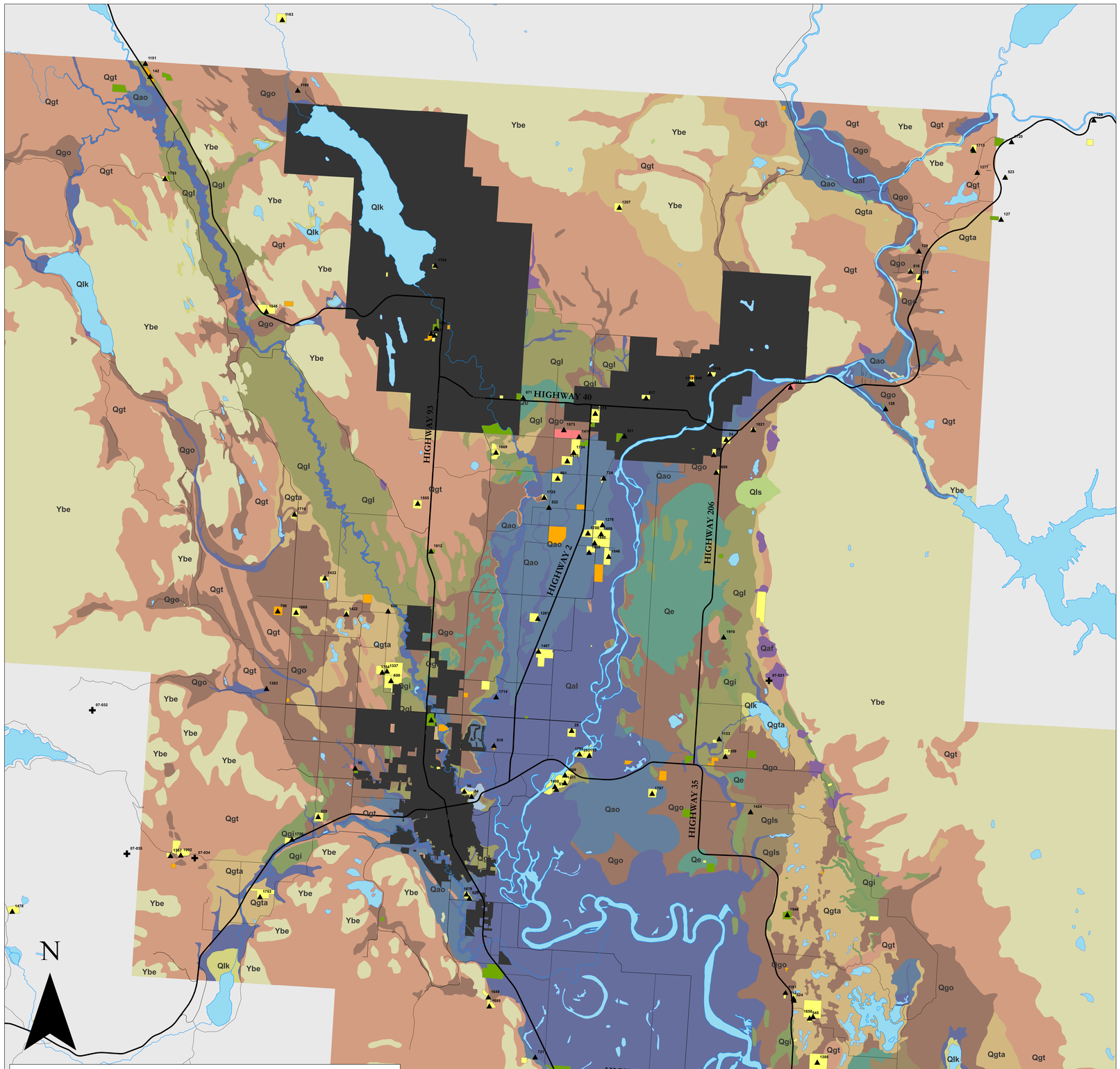
MAP 9.1

Gravel Resources Map

FLATHEAD COUNTY GROWTH POLICY



DESCRIPTION OF SOIL CLASSIFICATION UNITS

Qaf ALLUVIUM OF MODERN CHANNELS AND FLOODPLAINS (Holocene) - Light to medium brown and grayish brown sand and silt, and lesser amounts of pebbles, cobbles, and clay along active stream valleys and areas of streambed; contains minor amount of colluvium along the bases of steep slopes; thickness average 20 feet, but reach 50 feet in paleodrainages; south and southeast of Kalispell, ground water commonly near land surface; produces significant quantities of water.

Qal ALLUVIAL FAN DEPOSIT (Holocene) - Grayish brown and light to dark yellowish brown sand, silt, pebbles, cobbles, and boulders deposited in fan-shaped landforms downslope from canyon mouths; thickness range from 1 to 60 feet; ground water commonly near land surface;do produces wells.

Qe EOLIAN DEPOSIT (Holocene) - Dark to light yellowish brown fine and very fine grained well sorted sand deposited as eolian dunes and sand sheets; grains mostly of quartz with common argillic or calcareous rock fragments; petrified(?) casts of argillite, quartzite, and weakly consolidated siltstone occur as rare particles in deposits and locally as layers on or near the ground surface; a distinctive bed of whitish very pale orange volcanic ash (Mazama ash, 6845 ± 50 B.P.) is found in the upper part of the deposit in many places; thickness range from 1 to 20 feet; ground water commonly near surface; sandflow cross stratification are common in thicker deposits; the deposit is truncated near stream courses by alluvium;soils occur at the surface and buried within the deposit; dune forms are poorly preserved due to modification during stabilization and postpaleoceanal erosion; thickness range from 1 to 40 feet; water table is typically below the unit, but the unit may be saturated seasonally; not known to produce significant quantities of water.

Qls LANDSLIDE DEPOSIT (Holocene and upper Pleistocene) - Boulders, cobbles, and pebbles in a light to dark brown matrix of sand and silt; hummocky and locally with internal closed depressions; deposits are as much as 1 mile long and 1/2 mile wide; thickness range of unit is typically hundreds and locally in form; thickness range from 1 to 50 feet; ground water commonly near land surface; locally produces water.

Qlk ALLUVIUM, OLDER (Holocene) - Light to dark brown and grayish brown sand, pebbles, cobbles, and minor silt and clay; upper surface forms terraces near major stream valleys; topographic position intermediate between active stream valleys and areas of outwash deposition; thickness ranges from 1 to 40 feet; ground water commonly near land surface; produces significant quantities of water.

Qgo GLACIAL OUTWASH DEPOSIT (upper Pleistocene) - Light brownish gray and light to dark brown stratified gravel, sand, and silt; clasts of argillite, quartzite, and carbonate rocks; carbonate rocks are moderately to strongly weathered; surface is dotted with kettles, some of which are intersected cobbles and pebbles; rare boulders and larger clasts indicate bevelling; upper surface is broad and even with broad shallow depressions and abandoned glacio-fluvial channels; thicknesses average 50 feet and are locally more than 140 feet; ground water commonly near landsurface; produces significant quantities of water.

Qgl GLACIAL LAKE DEPOSIT (upper Pleistocene) - Light yellowish brown, pale brown, and light brownish gray, calcareous fine sandy silt, clayey silt, and minor clay; thin to medium laminations rhythmically alternate between darker-colored clay-rich laminae and lighter-colored and thicker silty and sandy laminae; deposit has broad, even surfaces except for few closed depressions; deposited from suspension in proglacial lakes formed behind glacial moraines; thicknesses average 150 feet and are locally greater than 270 feet; typically water-saturated,but produces little water to wells.

Qgls GLACIAL LAKE DEPOSIT, SANDY (upper Pleistocene) - Light yellowish brown fine to medium-grained sand, conglomerate, sandy silt, and minor clay; thin to medium laminations rhythmically alternate between darker-colored clay-rich layers and lighter-colored sand layers; deposit has broad, even surfaces except for few closed depressions; deposited from suspension in proglacial lakes; deposits have broad, flat surfaces and few closed depressions; thicknesses average 50 feet but locally are more than 80 feet; typically water-saturated,but only locally productive to water wells.

Qgl GLACIAL TILL (upper Pleistocene) - Predominately gravels, pebbles, cobbles, and boulders supported by a matrix of light gray, light brownish gray, pale yellowish brown, grayish orange, and pale brown, compact sandy or silty clam (diamicton) deposited by active glacial ice; minor amounts of stratified sand and gravel (stratified drift) deposited by flowing water; clast lithologies include light and medium brown gray metaarkosite, argillite, quartzite, and carbonate rocks; carbonate rocks are moderately to strongly weathered; surface is dotted with kettles; rare boulders of quartz that contains many fluid inclusions, apparently derived from the Purcell Lava of the Belt Supergroup, which is present in Glacier National Park and the Whitefish Range is about 10 miles north of Columbia Falls (Johns, 1970; McGimsey, 1985); clasts typically rounded and subangular; more resistant clasts are commonly striated; clasts of glacial landforms include drumlins and moraines; occurs as a veneer over Belt Supergroup rocks in most mountainous areas; glacial-fluvial channels cut across the unit and some of the drumlins and moraines; thicknesses average 50 feet and are locally more than 200 feet; typically water-saturated, but produces little water to wells except from basins of stratified drift.

Qgla GLACIAL TILL, ABLATION DEPOSIT (upper Pleistocene) - Gravelly, pebbly, and cobble conglomerate, and lesser amounts of light gray, to brownish gray, pale yellowish brown, grayish orange, and pale brown, compact beds of diamicton and stratified beds of sand; intermediate complex massive ML poorly bedded (ancestral deposits, and well-stratified (drift, formed during disintegration of glacial ice; characterized by knob and kettle topography with some elongated ceests of glacial landforms representing crevasse fills, eskers, and kames; thicknesses range from 1 to 150 feet; ahbu. lateral and vertical variations in lithology affect potential for groundwater development; typically produces water to wells in most locations.

Qgo GLACIAL ERRER DEPOSIT (upper Pleistocene) - Pebbles, cobbles, boulders, and some light to medium brown sand; most clasts are = gray, bedded quartzite, weathered carbonate rock fragments, and distinctive varieties of light gray to black Basalt (Purcell Lava); little matrix; whole rocks are common; thicknesses range from 1 to 60 feet; ground water levels typically below the unit, but the unit may be saturated seasonally; the unit is not known to produ significant quantities of water.

Qgl GLACIAL KO-CONTACT DE (POST (upper Pleistocene) - Light to dark brown and brownish gray pebble and cobble conglomerate with lesser amounts of laminated silt and clay; bedded sand, diamicton, and boulder conglomerate; clast lithologies dominated by rounded and subrounded argili metaarkosite, and quartzite with minor siltstone, sandstone, fossiliferous limestone, and distinctive cobbles of dark gray to black basalt (Purcell Lav and light gray to brownish gray carbonate rocks; carbonate rocks are moderately to strongly weathered; surface is dotted with kettles; rare boulders are common; conglomerate displays large and very large-scale tabular and trough cross-stratification; crude horizontal stratification in a matrix of gravel and coarse-grained sand, and clast imbrication; laminated silt and clay sequences are mostly less than a few feet thick and discontinuous in outcrop; sa occurs in cross-stratified, upward-fining beds, and as apparently massive, well-sorted beds with intercalated silt and clay laminae that show collap structures; diamictons are typically less than a few feet thick and occur as alternat-ing bodies and dipping beds apparently deposited by debris flows; for discussion of the origin of the deposit, see Pardee (1950), Alden (1953), Ericksen and Slack (1967), Ericksen (1968), Ericksen and Slack (1968), Ericksen (Gravelsr and Kaplan, 1969; Fink, 1971; Goldhaw1, 1970); changing proportion of lithologies causes unit to grade into areas mapped as ID-block deposits, and glacial erker deposits; thicknesses range from 1 to 150 feet; lateral and vertical variations in lithologyaffect potential for ground-wat development in the unit;typically productive to water wells in most locations.

Qgo GLACIAL OUTWASH DEPOSIT, OLDER (Pleistocene) - Light and medium brown, yellowish brown, and brownish gray gravelly, pebbly, a boulder conglomerate and coarse-grained sand; local calcium carbonate cement; clasts of quartzite and metaarkosite; rough crossstratified a channelized beds; clasts are imbricated; crops out beneath lit in steep exposures in the northeastern part of the mapand exposed thicknesses are als 150 feet (see CTDS, 7.7 Ft, 7, 10 W.); based on its location below Ed the unit correlates to upper part of the steep scale north of Flathead Lake.

QTs QUATERNARY OR TERTIARY SEDIMENT (Pleistocene or Tertiary) - Pale yellowish orange to grayish orange (dry), moderate to d-brown (moist), poorly sorted, fine to very coarse-grained sand, pebbles, cobbles, and boulders; clasts are dominantly quartzite; rare boulders of basalt and quartz occurs beneath light brown unweathered till in limited areas; diamicton may be either an older till (Duffer, 1960) or Tertiary debris f deposits (F. C. Ryan, written comm., 1990); exposed thickness about 30 feet; subsurface distribution and aquifer potential ofthe unit is poorly know however its stepy feature suggests the unit is not an aquifer.

Tk KISHENEHN FORMATION (upper Eocene-Miocene) - Yellowish brown to orange-medium and coarse-grained poorly sandstone with pec of carbonized wood fragments; pebble and cobble conglomerate, beds of carbonaceous shale, and light gray, dusky moderate yellow, and pale orange mudstone; conglomerate with silty, sandy matrix; well and moderately rounded clasts of argillite, quartzite, and orange siltstone; horizontal beds and beds dipping as much as 10 degrees; thickness of the formation is about 1,000 feet; conformably overlies Belt Supergroup rocks; contains numerous fractures; moderately indurated with calcium carbonate cement; calcium carbonate occurs locally as 0.5-M.C.F. thick rinds on clasts; abrupt dipo cemented fractures in sandstones; about 120 feet of section crops out in steep exposures (Constance, 1958); water wells completed in sandstone a conglomerate yield adequate supplies of water for household use in a few parcel the northeastern part of the map area and in the valley of the North F of the Flathead River.

Ybe BELT SUPERGROUP ROCKS, UNDIVIDED (Proterozoic Y) - Numerous stratigraphic units composed mostly of argillite, metaarkosite, ar quartzite (Johns, 1970; Winston, 1986; Harrison and others, 1992; 1998); and minor amount of igneous rocks (McGimsey, 1985); water wells completed fractured stone yield adequate supplies for household use.

TABLE - MDEQ OPEN CUT PERMITS

Permit Number	Operator	Mine Status
110	DEPARTMENT OF TRANSPORTATION	ACTIVE
111	DEPARTMENT OF TRANSPORTATION	ACTIVE
1118	COLUMBIA FALLS INDUSTRIAL PARK	ACTIVE
1119	COLUMBIA FALLS INDUSTRIAL PARK	ACTIVE
112	DEPARTMENT OF TRANSPORTATION	ACTIVE
1125	CLARK ED A	ACTIVE
1133	CRESTON TOPSOIL	ACTIVE
114	DEPARTMENT OF TRANSPORTATION	ACTIVE
1147	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1148	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
115	DEPARTMENT OF TRANSPORTATION	ACTIVE
1151	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1152	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1160	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1161	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1162	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1163	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1164	DEPARTMENT OF NATURAL RESOURCES STILLWATER UNIT	ACTIVE
1181	ESLICK PAUL	INACTIVE
12	ANDERSON LLOYD K	ACTIVE
1207	FH STOLTZE LAND AND LUMBER COMPANY	ACTIVE
126	DEPARTMENT OF TRANSPORTATION	ACTIVE
127	DEPARTMENT OF TRANSPORTATION	ACTIVE
1276	GOOSE BAY EQUIPMENT INC	ACTIVE
1277	GOOSE BAY EQUIPMENT INC	ACTIVE
128	DEPARTMENT OF TRANSPORTATION	ACTIVE
1281	GLACIER HORSE RANCH LLC	INACTIVE
129	DEPARTMENT OF TRANSPORTATION	ACTIVE
1298	GRIZZLY LOGGING AND LUMBER LLC DBA GRIZZLY GRAVEL PRODUCTS	ACTIVE
13	WAGONERS SAND AND GRAVEL	ACTIVE
130	DEPARTMENT OF TRANSPORTATION	ACTIVE
1305	HANSON NEIL	ACTIVE
1315	HAMILTON HOWARD D	ACTIVE
1320	HANSON NORMAN K	ACTIVE
1321	HANSON NORMAN K	INACTIVE
1337	HELENA SAND AND GRAVEL INC	ACTIVE
1383	KELLER LES	ACTIVE
1387	KLEMPEL JOE AND RON	ACTIVE
1388	KLEMPEL JOE AND RON	ACTIVE
1407	KNIFE RIVER	ACTIVE
1408	KNIFE RIVER	ACTIVE
1410	KNIFE RIVER	ACTIVE
1411	KNIFE RIVER	ACTIVE
1416	KNIFE RIVER	ACTIVE
142	DEPARTMENT OF TRANSPORTATION	ACTIVE
1422	KRUEGER GARY	ACTIVE
1424	LEIGHTY BROS CONSTRUCTION LLC	ACTIVE
1432	LHC INC	ACTIVE
1440	LASALLE SAND AND GRAVEL	ACTIVE
1478	MANY LAKES EAST	ACTIVE
1494	MURPHYS EXCAVATING INC	ACTIVE
1520	OLSEN RUSSELL	ACTIVE
1527	PLUM CREEK TIMBERLANDS LP	ACTIVE
1552	POTTS LYLE	INACTIVE
1555	PUMCO INC	ACTIVE
1559	RIVERSIDE CONTRACTING INC	ACTIVE
1640	RUSSELL KIMBERLY J	INACTIVE
1645	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1648	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1650	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1658	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1659	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1661	SCHELLINGER CONSTRUCTION COMPANY	INACTIVE
1668	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1669	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1679	SCHLEGEL AND SONS CONTRACTOR INC	ACTIVE
1685	SPOKUE GRANT	ACTIVE
1686	SPOKUE GRANT	ACTIVE
1713	SPOKUE ROBERT	ACTIVE
1714	STREET ROBIN	ACTIVE
1717	SILVERTIP PROPERTIES	ACTIVE
1719	STUPAK JAMES	ACTIVE
1720	STW PARTNERSHIP	ACTIVE
1721	SUDAN INC	ACTIVE
1724	SWIFT CREEK CABINS LLC	ACTIVE
1725	SCHWARZ CONSTRUCTION	ACTIVE
1726	CHARLAND STEVE R	ACTIVE
1731	TUNGSTEN HOLDINGS INC	ACTIVE
1733	TAMARACK HOLDINGS LLC	ACTIVE
1734	THORNBERRY RONALD AND ESTHER	ACTIVE
1743	TIMBERLINE READY MIX	ACTIVE
1753	TURNER WAYNE	ACTIVE
1754	TUTVEDT BRUCE	ACTIVE
1757	US FISH AND WILDLIFE SERVICE	ACTIVE
1769	WAGAR JOE	ACTIVE
1783	WOODRING ERIC	ACTIVE
1788	WHITE ROCK AGGREGATE LLC	ACTIVE
1797	WAGONERS SAND AND GRAVEL	ACTIVE
1798	WAGONERS SAND AND GRAVEL	ACTIVE
1807	SCHELLINGER CONSTRUCTION COMPANY	WITHDRAWN
1812	SCHELLINGER CONSTRUCTION COMPANY	INACTIVE
1821	PLUM CREEK TIMBERLANDS LP	DENIED
1846	WHITE ROCK AGGREGATE LLC	ACTIVE
1873	KNIFE RIVER	PENDING
1886	JTL GROUP INC - KALISPELL	INACTIVE
1910	WILKE LAURENCE G	DENIED
1946	SCHELLINGER CONSTRUCTION COMPANY	ACTIVE
1991	DEPARTMENT OF TRANSPORTATION	ACTIVE
1992	GRIZZLY LOGGING AND LUMBER LLC DBA GRIZZLY GRAVEL PRODUCTS	ACTIVE
2	PACK AND COMPANY	INACTIVE
2006	ESLICK PAUL	PENDING
2031	WAGONERS SAND AND GRAVEL	ACTIVE
24	DOANE DON	ACTIVE
25	ROBINSON SAND AND GRAVEL	ACTIVE
3	CITY OF WHITEFISH	ACTIVE
30	JTL GROUP DBA MCELROY AND WILKEN	ACTIVE
305	DOTEN NEIL	ACTIVE
38	NORVELL LINDA EVART	ACTIVE
486	PLUM CREEK TIMBERLANDS LP	ACTIVE
500	PLUM CREEK TIMBERLANDS LP	ACTIVE
515	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
516	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
517	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
518	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
519	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
520	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
521	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
522	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
523	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
524	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
525	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
526	FLATHEAD COUNTY ROAD DEPARTMENT	ACTIVE
54	JTL GROUP DBA MCELROY AND WILKEN	ACTIVE
545	MISSION VALLEY CONCRETE	ACTIVE
55	PACK AND COMPANY	ACTIVE
650	LHC INC	ACTIVE
661	THORNBERRY RONALD AND ESTHER	ACTIVE
671	AC ENTERPRISES LLC	ACTIVE
706	BEASLEY JOE	ACTIVE
721	BROWNN PAMELA	ACTIVE
724	BRASH PROJECTS LLC	ACTIVE
83	HAMILTON HOWARD D	ACTIVE
1	RUSSELL WILLIAM M	ACTIVE
1	SPOKUE ROBERT	INACTIVE

TABLE - MDEQ SMALL MINER EXCLUSION STATEMENTS

PROGRAM	COMPANY NAME	OPERATION TYPE	MINERAL	STATUS
07-015	KEARNS(FB) BRYAN K	OPEN PIT	TALUS	SELFTOWN
07-021	JENSEN PAUL	OPEN PIT	SHALE, ROCK	ACTIVE
07-027	JARVIS WILLIAM	ROCK PICKER	RIP RAP ROCK	ACTIVE
07-032	F H STOLTZE LAND & LUMBER CO	OPEN PIT	ROCK	ACTIVE
07-034	GRIZZLY LOGGING & GRAVEL PRODUCTS INC	ROCK PICKER	ROCK	ACTIVE
07-035	KLEMPEL JOE & GINA	OPEN PIT	ROCK	ACTIVE
07-036	ANDERSON MASONRY INC	OPEN PIT	DECORATIVE ROCK	ACTIVE

TABLE - MDEQ OPERATING PERMITS, HARD ROCK

PROGRAM	MINE NAME	OPERATION TYPE	MINERAL	STATUS
00065	ESSEX QUARRY	OPEN PIT	BALLAST, RIP-RAP	ACTIVE
00123	HOG HEAVEN MINE	OPEN PIT, UNDERGROUND, VAT LEACH	COPPER, GOLD, LEAD, OXIDES, SULFIDE, ZINC	ACTIVE
00161	MEADOW GRAVEL QUARRY	OPEN PIT	TALUS, ROCK	ACTIVE
00191	MULTIPLE QUARRY PERMIT	MULTIPLE QUARRY SITES	ROCK	ACTIVE
00225	MULTIPLE QUARRY PERMIT	GENERAL QUARRY	ROCK	ACTIVE

Legend

- Small Miner Exclusion Statements - Hard Rock
- Existing MDEQ Open-Cut Permits
- Rivers, Lakes & Streams

Gravel Pits: Flathead County Inventory (thru 2006)

- ACTIVE
- INACTIVE
- RECLAIMED
- UNKNOWN
- City Planning Jurisdictions/Interlocal Agreement Areas

Surficial Soils: MT Bureau of Mines and Geology

- QTs - Quaternary or Tertiary Sediment
- Qaf - Alluvial Fan Deposit
- Qal - Alluvium of Modern Channels and Floodplains
- Qao - Alluvium, Older
- Qe - Eolian Deposit
- Qge - Glacial Esker Deposit
- Qgi - Glacial Ice Contact Deposit
- Qgl - Glacial Lake Deposit
- Qgls - Glacial Lake Deposit, Sandy
- Qgo - Glacial Outwash Deposit
- Qgoo - Glacial Outwash Deposit, Older
- Qgt - Glacial Till
- Qgta - Glacial Till, Ablation Deposit
- Qlk - Lake Deposit
- Qls - Landslide Deposit
- Qoa - Unidentified
- Tk - Kishenehn Formation
- Ybe - Belt Supergroup Rocks, Undivided

DRAFT

0 1 2 4 6 Miles