16 June 1988

TO: Mr. James Marshall
Mr. Paul Chalmers
Mr. James Braithwaite

FROM: S. N. Stephenson

SUBJECT: Description of 1-4 Dioxane contaminated property at Gelman Sciences, 600 South Wagner Road, Ann Arbor, Michigan.

For the purposes of this report the site (located in Section 26, of Scio Township [T2 S, R5 E]) will be referred to as "the bog".

Purpose: The purpose of this investigation was to provide a site description, including extant vegetation composition, soil type(s) and fauna associated with a land parcel of approximately 5 acres that is known to be contaminated with the industrial solvent 1-4 dioxane. Specifically, this includes the plant species observed (identified to species where possible), and the abundance of these species as estimated from visual inspection of the area or from actual counts on specified, randomly selected plots or transects; an inspection of the soil-substrate profile and collection of samples for laboratory analysis from various points throughout the bog; and a record of the vertebrate fauna observed during the site visits June 7 and June 15, 1988.

These data will be used to, 1) aid in interpretation of the origin and development of the extant vegetation and physical characteristics of the bog, 2) to provide a basis for estimating the effects of 1-4 dioxane contamination on the extant biota, 3) to determine if the site harbors any taxa (species, or other classification) of biota presently listed as rare, threatened or endangered under Michigan Act. No. 203 of 1974, and 4) to provide an estimate of the effects on the biota of constructing a trench for the purposes of collecting ground water.

The observations, data, and materials collected that are referred to hereafter were collected during a site visit on 15 June 1988.

Results

Vegetation analysis: Figure 1* shows the present distribution of the general vegetation types occurring in the bog. Table 1 is a list of the species observed and/or collected for identification in the laboratory.

The vegetation of the bog is dominated over most of its area by a small number of woody species, mostly shrubs, and in some classifications would be considered a "shrub carr". The dominant species is buckthorn (Rhamnus frangula), an introduced shrub that is

*The layout for Figure 1 was adapted from a reduction of an aerial photograph provided by Mr. Paul Chalmers, Gelman Sciences.

becoming a serious problem in the management of natural wetlands in southern Lower Michigan (Voss 1985). The native dogwoods (Cornus amomum and C. foemina), and willow (Salix sp.) form the major portion of the dominant plant cover. With the exception of the two herb dominated openings, these shrubs collectively produce a more or less closed canopy (100% cover) 2 to 4 meters above the ground surface. Because of the deep shade conditions the ground cover is short and consists mainly of buckthorn seedlings (up to 2000/m^2). All of these species are characteristic of a variety of sites with very wet to saturated soils.

The few trees are all present in small size classes, indicating relatively recent invasion (past 30± years or so). The maples and elm species are wind dispersed, and the aspen is most likely residual from the original vegetation, although it too may become established from wind dispersed seed.

The two herb dominated openings occupy areas that are apparently slightly lower in elevation than the remainder of the bog, and support a nearly closed (100%) cover of grasses and sedges. Two grasses, the native bluejoint reed grass (Calamagrostis canadensis) and the introduced reed canary grass (Phalaris arundinacea) and two sedges, both native, (Carex aquatilis and C. atherodes) form the matrix of this cover type, within which there are a variety of other herbs and a few invading shrubs.

Near the centers of these openings are areas that were apparently last covered with water; here there is more bare sediment and the mixture of species, including Alisma plantago-aquatica, Ranunculus scleratus and Cicuta maculata, suggests that the areas usually have standing water.

This vegetation complex is characteristic of wetlands succession and can be observed in a wide variety of sites in southern Michigan where it has been generated by a wide variety of land use practices. Prominent among these are the clearing of former swamp forests with or without subsequent draining, draining of bogs, draining of marshes, and abandonment of agricultural attempts on waterlogged organic soils. This complex is also frequently observed around the margins, i. e., on the oldest surfaces, of undisturbed "peat bogs" in southern Michigan.

Of the 104 species recorded from the site on June 15, 54 (52%) are characteristic of wetlands habitats. The remainder are opportunistic invaders in a variety of habitats, and many of these (approx. 26% of the total flora) are non native taxa. Some of the latter were confined to the disturbed site near the northeast corner of the bog, but the occurrence of some species probably resulted from the drought conditions of the year.

Soils analysis:

The soil surface of the entire area is very dark brown to black, soft, and consists of a sapric matrix within which variable amounts of fibrous materials are imbedded. Because of the drought conditions that had prevailed for several weeks prior to the survey the surface

was relatively dry except in the centers of the two open, herb dominated sites (Figure 1) where the surface was moist to the touch.

The bed of the Honey Creek tributary was, at the time of the survey, dry (contained no standing water) but was saturated (i. e., foot prints would accumulate water in a short time). The sediments in this feature appeared to be a mixture of marl, surface organic soil and imported debris.

A disturbed area at the east end of the bog next to the road had blocky peat on the surface and what appeared to be the side of the excavation of a drain improvement.

Six one-meter depth soil probes were made at more or less randomly selected points over the area of the bog to determine if there were obvious correlations between the present vegetation pattern (variations in species composition and abundance) and the underlying soils. The results are presented in Table 2.

In general there was little variation in the nature of the upper one meter over the entire area sampled; the surface 0 - 30 cm uniformly graded from very dark brown or black to dark reddish brown, and fibrous material increased with depth. At approximately 30 to 40 cm a light grey marl was encountered in five of the probes, and this continued to 100 cm. The exception (#2) was dark red fibrous organic material for the full 100 cm. In all cases the lowest portion of the soil core was "drippy" wet, and at #5 the sediments were too wet to catch a complete core.

The marl is typical of that that can be seen in the lowest sedimentary strata of basins associated with oligotrophic water bodies in Michigan, both acid and basic. It is light gray, fine textured matrix material with bits of lighter colored shell scattered throughout the matrix.

Conclusions:

1. Present soil-sediment conditions and origin of the bog

The site surveyed, herein referred to as "the bog", appears to have developed in a shallow water filled depression with a limited watershed, and perhaps was isolated from the main regional or local drainage pattern. Such isolation permitted the accumulation of calcium rich organic sediments (the marl), and at the same time reduced the inorganic nutrients in the water column leading an aquatic environment favorable to the formation of peat. Although the peat layer is thin relative to other acid or sphagnum bogs, both undisturbed and those that have been altered by draining or dredging that I have examined in southern Michigan, the presence of peat of sphagnum origin clearly indicates that the site was at one time a bog or is a remnant of a once more extensive bog complex.

The present day condition of the surface sediments which approach the color and consistency of "muck" soils indicates a prolonged history of drying. This has led to increased oxidation and decay of the surface peat, and probably resulted in large part from improved drainage when the Honey Creek tributary was straightened and almost

certainly deepened.

2. Composition and origin of the present vegetation complex

From the standpoint of vegetation classification the present day vegetation would not be classified as bog vegetation. The term bog is generally restricted to sites supporting a specific complex of species that are more or less restricted to saturated, acid, and nutrient poor substrates. These conditions are generally brought about by isolation from local or regional hydrologies through perching of local water tables. When water levels are lowered in such sites for periods of sufficient duration to allow decay or mineralization of the peat more nutrient demanding species can and do become established. That is what we see today in "the bog".

The displacement of native bog species in undisturbed bogs by, among others, those observed in "the bog" today is also a natural process. But, it occurs from the outer portions of the basin toward the center, i. e., on the oldest bog surfaces. An exception is the invasion by buckthorn noted earlier. Eventually all bogs will fill with autochthonous (self generated) sediments, and become "dry land". In the present case it would appear that past landscape manipulations have greatly accelerated the process and the site now supports an advanced successional wetland plant community. Although this type of plant community may be observed at other sites with differing hydrologies in this region (e. g., lacustrine or riparian swamp forest that has been cleared), it does not necessarily indicate that the original hydrology of "the bog" has been substantially altered below the level of "Honey Creek".

3. Presence of "special concern taxa" (rare, threatened or endangered species)

No plant species that are currently listed as rare, threatened or endangered in Michigan, or otherwise protected under Michigan law (e. g., under the "Christmas Tree Act"), were observed in the bog. I would add this caveat; there were one or more species of Aster observed in the bog, but these were not sufficiently developed to make a definite identification. That one of the protected species of Aster occurs in this site is unlikely, however it is a possibility.

4. Effects of 1 - 4 dioxane contamination on the biota

The condition of the vegetation in "the bog" is comparable to similar species arrays that I have observed in many sites in southern Michigan. There were no abnormal growth forms, and aside from some signs of high heat - low moisture stress during the afternoon hours in some of the herbaceous species on June 15, all of the species appeared to be normal for this time of year.

5. Effects of construction of ground water catchment ditch

Other than disturbance in the immediate area of the ditch (the ditch itself and disturbance caused by machinery, etc.) there would probably be little short term change in the vegetation. Ditching to a depth of 3 m will lower the water table only a maximum of 2 m if the ditch is maintained in an empty condition. Most of the dominant species in "the bog" today are capable of persisting in far drier conditions than would be created by lowering the water table by 2 m. Some of the more moisture demanding species may be negatively affected near the ditch(s), however, the net result will likely be a simple replacement by less moisture demanding species.

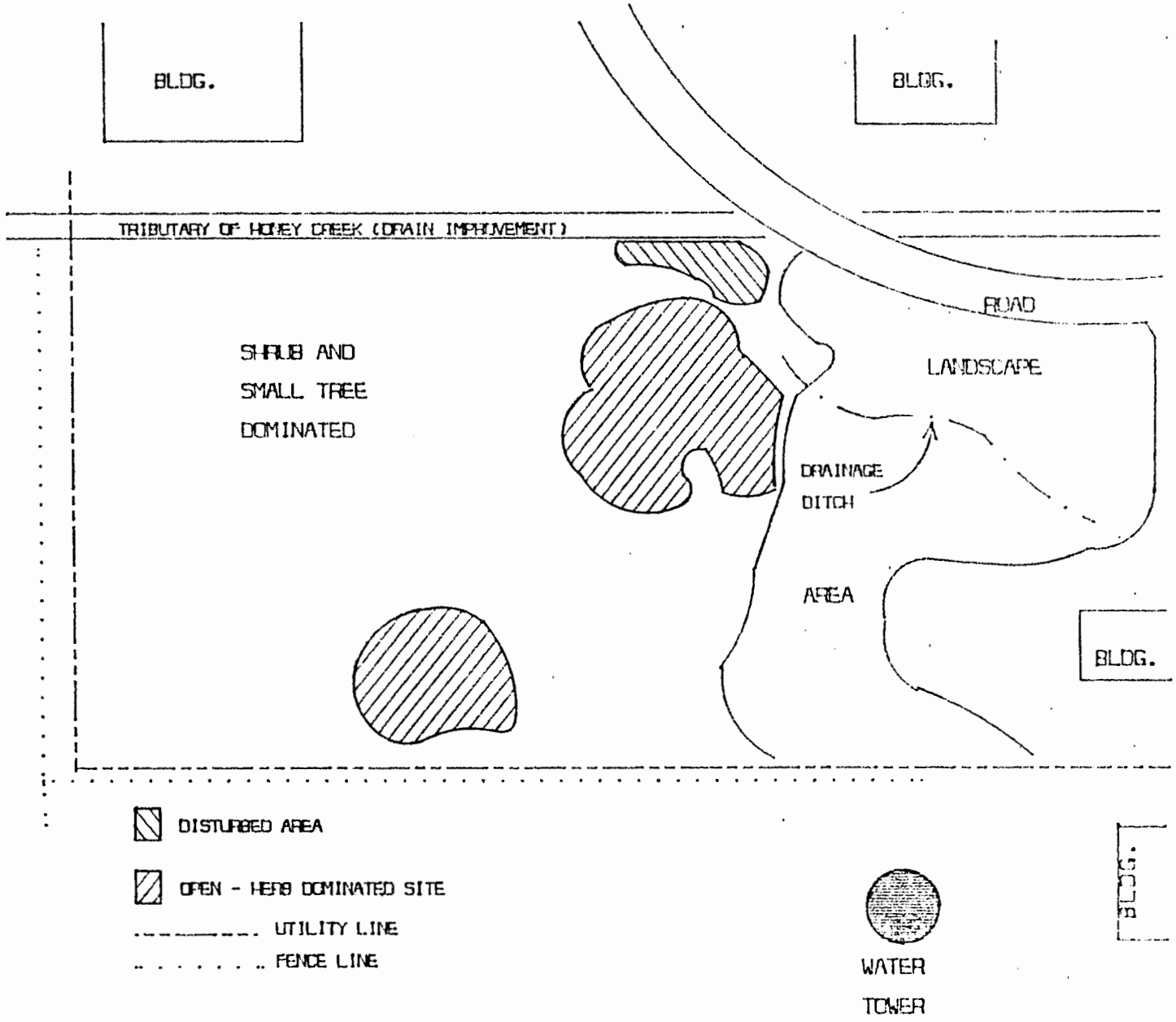
BLDG.
BLDG.
TRIBUTARY OF HONEY CREEK (DRAIN IMPROVEMENT)
ROAD
SHRUB AND
SMALL TREE
DOMINATED
LANDSCAPE
DRAINAGE
DITCH
AREA
BLDG.
DISTURBED AREA
OPEN - HERB DOMINATED SITE
UTILITY LINE
FENCE LINE
WATER
TOWER
BLDG.

FIGURE 1

Table 1. Alphabetical listing of the plant species (flora) observed and/or collected in the area of Figure 1, 15 June 1988.

Explanation of symbols used: Technical names are underlined, followed by common names. Usage follows Voss (1972, 1985) and Gleason and Chronquist (1963). Technical names incorporating a "cf." indicate that an absolute indentification was not possible with the materials observed (for example from seedling materials, or where there is a long standing taxonomic problem). Technical names incorporating an "sp." indicates that the identification is only to genus (most, if not all, of these species can be identifed with certainty at a later date, but at the time of the survey they were incompletely developed). Species followed by an asterisk (*) are characteristic of wetlands, but not necessarily limited to them; those species followed by a double asterisk (**) are more or less limited to wetlands.

Tree species

Acer negundo box elder *
A. rubrum red maple*
A. saccharinum silver maple*
Ailanthus altissima tree of heaven (introduced)
Populus tremuloides quaking aspen*
Ulmus americana elm*

Shrub species

Cornus amomum dogwood*
C. foemina grey dogwood*
Crataegus sp. hawthorn (seedlings)
Lonicera cf. canadensis honeysuckle
Rhamnus frangula buckthorn* (introduced)
Ribes sp. gooseberry
Rosa palustris swamp rose**
R. multiflora multiflora rose (introduced)
Rubus sp. blackberry
Rubus cf. idaeus raspberry
Salix sp. willow*
Sambucus sp. elderberry
Spirea alba spirea*

Vine species

Parthenocissus quinquefolia virginia creeper
Toxicodendron radicans poison ivy
Vitis sp. wild grape

Herbaceous species

Agrimonia sp.
Alisma plantago-aquatica water plantain**

Ambrosia artemisiifolia common ragweed
A. trifida giant ragweed*
Arctium minus burdock (introduced)
Asclepias incarnata swamp milkweed**
Aster spp.
Barbarea vulgaris winter cress (introduced)
Bidens sp. spanish needles**
Boehmeria cylindrica false nettle**
Calamagrostis canadensis bluejoint reed grass*
Carex spp.**
Carex aquatilis sedge**
C. atherodes sedge**
C. stipata sedge**
C. cf. anectens sedge*
C. cf. alopecoidea sedge*
Chenopodium album lamb's quarters (introduced)
Chrysanthemum leucanthemum oxeye daisy (introduced)
Cicuta maculata poison hemlock**
Cirsium vulgare bull thistle (introduced)
C. arvense Canadian or field thistle (introduced)
Convolvulus arvensis bindweed (introduced)
Daucus carrota wild carrot (introduced)
Eleocharis cf. smallii**
Erigeron annuus fleabane
Eupatorium cf. maculatum joe pye weed*
Fragraria sp. strawberry
Galium tinctorium bedstraw**
G. triflorum bedstraw
Geum cf. canadensis avens
Glyceria striata manna grass*
Impatiens sp. jewel weed**
Iris virginica iris**
Juncus effusus rush**
Lathyrus palustris wild pea*
Leersia virginica rice cut grass*
L. oryzoides rice cut grass*
Linaria vulgaris toad flax (introduced)
Ludwigia palustris ludwigia**
Lycopus cf. americana water horehound**
Oxalis sp. sheep sorrel
Medicago lupulina black medic (introduced)
Melilotus sp. sweet clover (introduced)
Mentha cf. arvensis field mint* (possibly introduced)
Muhlenbergia sp. wire stem muhly (grass)*
Oenothera cf. biennis evening primrose
Onoclea sensibilis sensitive fern**
Panicum cf. capillare witchgrass
Phalaris arundinacea reed canary grass* (introduced)
Poa pratensis bluegrass
P. annua annual bluegrass
P. palustris fowl meadow grass**
P. compressa Canada bluegrass

Polygonum sagittatum tear thumb*
P. cf. persicaria smartweed** (introduced)
P. cf. convolvulus vining buckwheat (introduced)
P. spp.**
Potentilla sp. cinquefoil (probably introduced)
Ranunculus abortivis crowfoot, buttercup
R. scleratus crowfoot**
R. pensylvanicus buttercup*
Rorippa sp. marsh cress** (possibly introduced)
Rumex crispus dock (introduced)
R. cf. verticillatus water dock**
Scirpus sp. bulrush**
Sium suave wild parshnip**
Solanum dulcamara bittersweet nightshade* (introduced)
Solidago canadensis goldenrod
S. graminifolia goldenrod
Sparganium sp. bulrush**
Sphenopholis intermedia wedgescale grass
Stellaria gramineae chickweed (Washtenaw County record)
Taraxacum officinale dandelion (introduced)
Thalictrum dasycarpum meadow rue*
Trifolium sp. clover (introduced)
Typha latifolia cattail**
Urtica dioica stinging nettle*
Verbascum thapsus moth mullien (introduced)
Verberna cf. urticifolia vervain
Veronica arvensis veronica (introduced)
Viola sp. violet

TABLE 2

Results of soil samples:

Sample locations are keyed to Figure 2. Samples were obtained using a standard tubular soil probe, and extended to a maximum depth of one (1) meter.

	DEPTH		
SAMPLE	0 - 30 CM	30 - 60 CM	60 - 100 CM
#1	Dark brown fibrous below surface	light grey marl with whitish shell fragments moist	same; drippy (saturated)
#2	Same as #1	dark reddish brown; fibrous; blocky; very moist	dark reddish brown; blocky peat; very moist
#3	Same as #1	same as #1	same as #1
#4	Very dark brown to nearly black degraded peat	upper 5 cm peat, grading rapidly into marl as in #1	same as #1
#5	Same as #1	reddish peat in upper 10 cm; grading to marl; very wet	saturated; too wet to catch a sample
#6	Same as #1	same as #5	marl; saturated, but firm