fish was collected from the site 1 mile below the Dunn Creek confluence, we hypothesize that it may have lived much of its life within the immediate influence of the Dunn Creek mine-impacted flows.

Table 8. Marsh Creek Fish Composite Samples (Whole Fish) Mercury Concentrations *(fresh/wet weight ppm Hg)*

Species	Weight (g)	Length (mm)	Individuals in Comp.	Hg (wet wt ppm)
1 mile above Dunn Ck Confluence				
California Roach	4.2	72	n=1	0.21
1 mile below Dunn Ck Confluence				
California Roach	4.1	72	n=2	0.20
" "	9.0	93	n=1	0.71
~5 miles below Dunn Ck confluence				
California Roach	1.5	52	n=11	0.25
and	2.2	63	n=16	0.23
juvenile Hitch	4.0	72	n=19	0.19
" "	7.5	85	n=5	0.18
" "	19.2	115	n=1	0.24
1 mile above Marsh Ck Reservoir				
California Roach	2.8	65	n=5	0.13
" "	4.0	76	n=3	0.24
" "	6.9	84	n=2	0.15
0.5 mile below Marsh Ck Reservoir				
juvenile Bluegill	1.7	50	n=9	0.24
" "	3.4	61	n=3	0.19
" "	5.4	70	n=3	0.21
Downstream near Oakley				
juvenile Salmon	3.6	70	n=5	0.07

A collection of larger hitch individuals (72-117 g, 1-3 yrs) was made one mile above the reservoir. We also noted several large goldfish in the creek at this location, which were likely the grown results of earlier releases by the public. Large fish were not found in the creek upstream of this region. Muscle mercury concentrations in the 8 larger hitch taken upstream of Marsh Creek Reservoir, at 0.29-0.51 ppm (Table 9), were very similar to levels measured in adult hitch within the reservoir (section 3.2.3, Table 11).

The juvenile bluegill samples taken immediately below the reservoir were similar in both size and mercury concentration to upstream roach and juvenile hitch, on a whole body

Table 9. Marsh Creek Fish Muscle (Fillet) Mercury Concentrations
(fresh/wet weight ppm Hg)

Identification	Weight (g)	Length (mm)	Muscle Hg (wet wt ppm)
1 mile above Marsh Ck Reservoir			
Hitch	72	177	0.44
"	73	181	0.30
"	88	194	0.40
"	90	196	0.35
"	97	197	0.51
"	106	208	0.51
"	114	205	0.46
"	117	205	0.29
0.5 mile below Marsh Ck Reservoir			
juvenile Bluegill	5.2	68	0.22
" "	5.3	71	0.35
" "	5.8	71	0.40
Downstream near Oakley			
juvenile Salmon	2.2	60	0.01
" "	2.5	63	0.01
" "	3.9	72	0.06
" "	4.0	72	0.06
" "	5.6	80	0.02
1 yr Bluegill	22	113	0.05
Crayfish (tail meat)	8.5	39¥	0.04
" "	12.2	39¥	0.03
" "	16.8	41¥	0.04

¥ Lengths for crayfish are standard carapace lengths, not total lengths.

composite basis (1.7-5.4 g, 0.19-0.24 ppm Hg). While these are quite different fish species, at this small size their feeding habits are relatively similar, with food items dominated by small in-stream invertebrates. The similar mercury concentrations measured at this time indicate that bioavailable mercury had been moving out of and/or through the reservoir in previous months. The aqueous mercury data (section 3.1.1.2) indicates that this was clearly the case under post-storm, high flow conditions. In addition to whole body composites, we analyzed muscle mercury in several 5-6 g juvenile bluegill taken downstream of the reservoir (Table 9). Muscle concentrations were somewhat higher than the whole body levels (0.22-0.40 ppm muscle vs 0.19-0.24 whole body). This is often the case. In ongoing research at the University of California, we repeatedly find muscle tissue to be the major repository for mercury in fish (Reuter et al. 1989, Slotton 1991, Suchanek et al. 1993, Slotton et al. 1996).

The samples taken from downstream Marsh Creek near Oakley provide some interesting comparative information. Here, we collected five small parr salmon (2-6 g), a one year old bluegill (22 g), and several adult crayfish. Muscle mercury in all of these samples, as well as composite mercury in the parr salmon, was significantly lower than that seen in fish from upstream Marsh Creek and the reservoir. Concentrations were all ≤ 0.07 ppm Hg. Once again, while the upstream roach and juvenile hitch are very different fish than the juvenile salmon, at this small size they are quite similar in body form and in the diet imposed by their size. Salmon parr such as these were almost certainly born in the only gravel spawning areas available on Marsh Creek downstream of the reservoir; i.e. just below the reservoir. As they only migrate downstream at this life stage (Moyle 1976), they could not have originated from outside of the watershed. Therefore, the mercury in these samples provides a reasonable measure of mercury bioavailability in downstream Marsh Creek, as compared to upper watershed roach and juvenile hitch of the same size. The levels were approximately one third of concentrations seen upstream.

While the direct comparison between parr salmon and roach of the same size may be complicated by the fact that roach of the same size can be considerably older, we found the same trend in the other samples. The bluegill taken near Oakley was also very low in mercury (0.05 ppm), despite being considerably larger than the comparative samples from just below the reservoir. Similarly, the crayfish tail meat samples were all very low, at 0.03-0.04 ppm Hg. These organisms are relatively sedentary as compared to fish, and can thus provide a good measure of localized conditions, integrated over their lifespans. In our work with crayfish throughout the Sierra Nevada, we have consistently found them to contain mercury at levels greater even than co-occurring hellgrammites, with concentrations generally similar to those of local fish (Slotton et al. 1995a). This results from their consumption of dead fish, the preferred food of these scavengers. On a comparable dry weight basis, the crayfish tail meat concentrations near Oakley were 0.15-0.20 ppm Hg. This is considerably lower than invertebrate samples of any trophic level taken between the Mt. Diablo mine area and the reservoir, and much lower than the hellgrammite mercury concentrations, which ranged from 0.50 ppm to far greater levels.

3.2 Marsh Creek Reservoir

3.2.1 Reservoir Sediment

Table 10. Marsh Creek Reservoir Sediment Laboratory Data

Identification	Sediment Depth (cm)	(inches)	Hg (dry wt ppm)	% Water	% Organic (dry wt)
Surficial Sediment--Large (East) Basin					
SW Quadrant	(surficial sediment)		0.49	75.1%	5.8%
SE Quadrant	(surficial sediment)		0.35	69.5%	4.7%
NE Quadrant	(surficial sediment)		0.46	70.6%	4.3%
NW Quadrant	(surficial sediment)		0.44	67.0%	5.6%
Center	(surficial sediment)		0.47	70.6%	4.3%
Surficial Sediment--Small (West) Basin					
N Side	(surficial sediment)		0.39	50.9%	4.2%
S Side	(surficial sediment)		0.46	53.1%	4.5%
Center	(surficial sediment)		0.49	48.4%	3.9%
Core 1: Large (East) Basin--Center					
section 1	5	2	0.53	53.4%	5.7%
section 2	24	9	0.54	46.5%	4.3%
section 3	42	17	0.71	54.8%	5.9%
section 4	60	24	0.64	53.7%	4.4%
section 5	78	31	0.80	40.7%	3.8%
section 6	97	38	1.48	51.4%	6.4%
section 7	115	45	0.58	49.2%	4.0%
section 8	129	51	0.68	40.0%	3.4%
section 9	139	55	0.36	35.3%	3.4%
section 10	148	58	0.24	21.8%	1.2%
Core 2: Small (West) Basin--Center					
section 1	5	2	0.58	49.7%	5.5%
section 2	23	9	0.52	46.4%	6.0%
section 3	41	16	0.51	40.6%	5.4%
section 4	57	22	0.41	34.7%	5.5%
section 5	77	30	0.36	33.7%	5.3%
section 6	100	39	0.71	49.8%	6.4%
section 7	122	48	0.52	38.5%	4.4%
section 8	145	57	1.03	39.7%	5.3%

We characterized the current mercury concentrations in Marsh Creek Reservoir bottom sediments by sampling surficial bottom sediment at 8 locations distributed throughout the reservoir. The record of historic mercury deposition in the reservoir was determined by taking extended sediment cores into the bottom at the centers of each of the two main

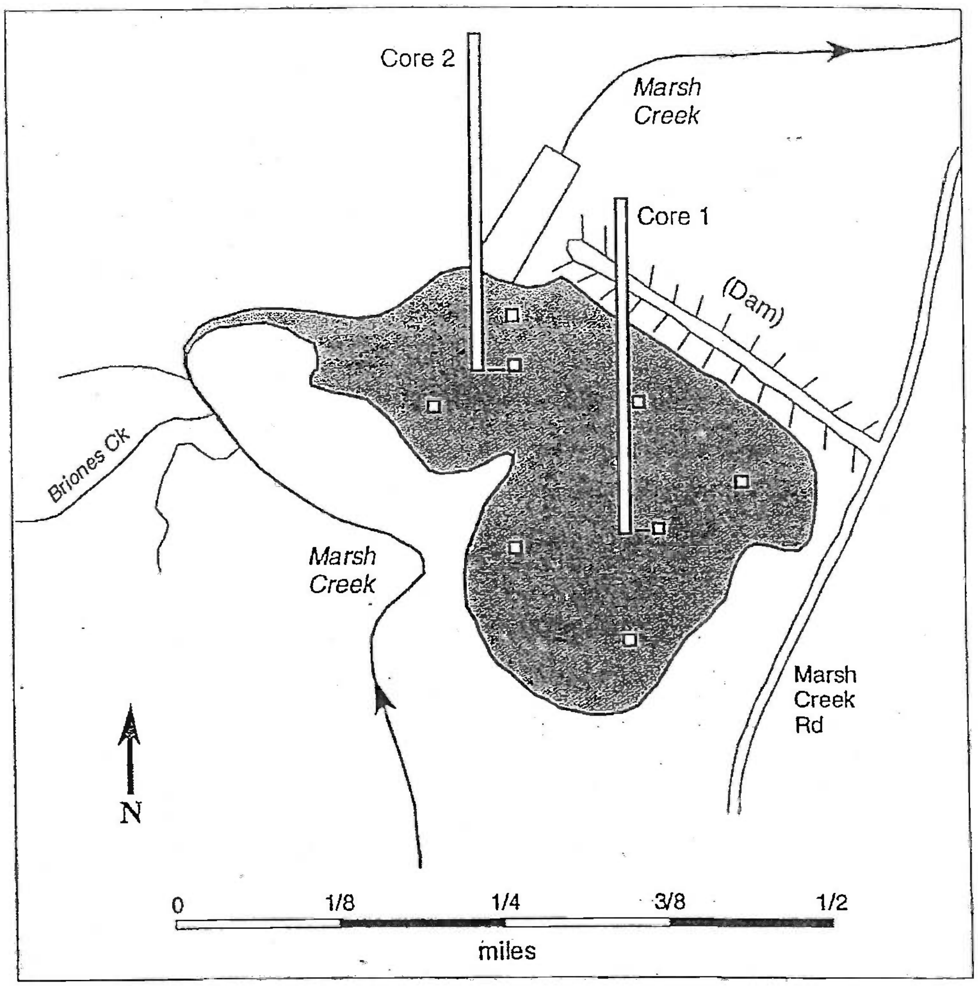


Figure 18. Marsh Creek Reservoir Sediment Sampling Sites
(September 1995)

□ – Surficial sediment sampling sites

basins. These cores were sectioned and analyzed throughout their lengths for mercury and general sediment parameters. The reservoir sediment data is presented in Table 10. Sampling locations are displayed in Figure 18. Graphic representations of the core data are shown in Figures 19 and 20.

Surficial sediment mercury concentrations, which correspond to the most recent deposition from the watershed, were very similar throughout the reservoir at 0.35-0.49 ppm (mean = 0.44 ppm). This is very comparable to the 0.40 ppm result obtained by Levine-Fricke (1993a) for a sediment sample taken within the water line of the reservoir in July 1993. While mercury levels were relatively uniform, the sediment character was somewhat different between the two basins. The surficial sediment in the larger, eastern basin was higher in moisture content and somewhat higher in the percentage of organic matter. This is consistent with the smaller, western basin being the location of the direct inflows from Marsh Creek. The associated inputs of new sediment from the watershed will initially be of larger grain size and lower moisture percentage near the inflow, as that is where the heavier material will drop out of the water as the current slows. New deposition in other areas of the lake, further away from the inflow, will be dominated by the fine particulates which remain suspended in the water long enough to reach those areas. Subsequent increases in organic percentage and moisture content are particularly likely where there is extensive weed growth, as has been the case in this shallow reservoir.

The core taken in the center of the large, eastern basin (Core 1) reached all the way to the original terrestrial bottom material, which was nearly five feet beneath the current sediment/water interface. As the reservoir was built in 1963, this profile includes the entire 32 year history of sediment deposition from 1963 to 1995. The underlying terrestrial material was distinctive in its orange/tan coloration, crumbly texture, and dryness, as compared to the gray to black, fine sediments that constituted the subsequent aquatic sediment deposition.

Core sub-samples for laboratory analysis were taken within homogeneous sections of the core, rather than at specific intervals. Different periods of deposition were apparent in the core record as distinct color and textural shifts, with uniform bands of gray, black, and intermediate shades. The underlying terrestrial soil was quite different visually from any of the overlying material. The profiles of laboratory analytical parameters show this as well (Fig. 19). The values for mercury concentration, moisture content, and organic percentage were notably lower in the terrestrial material, as compared to the overlying aquatic sections of the core. Within the aquatic sediment layers, values of all three parameters varied within relatively narrow ranges. In the top 4.5 feet of the Core 1 sediment, mercury ranged between 0.5 and 1.5 ppm, moisture content was 40-55%, and organic percentage ranged

Figure 19. Marsh Creek Reservoir 1995 Sediment Core 1:
Larger, Eastern Basin Profiles

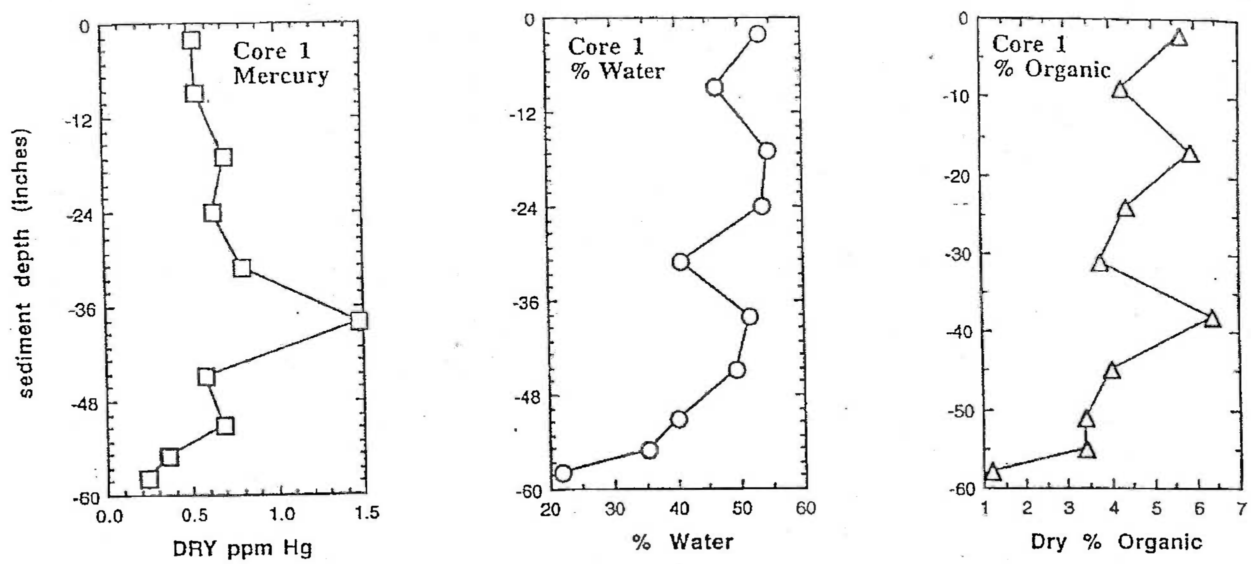
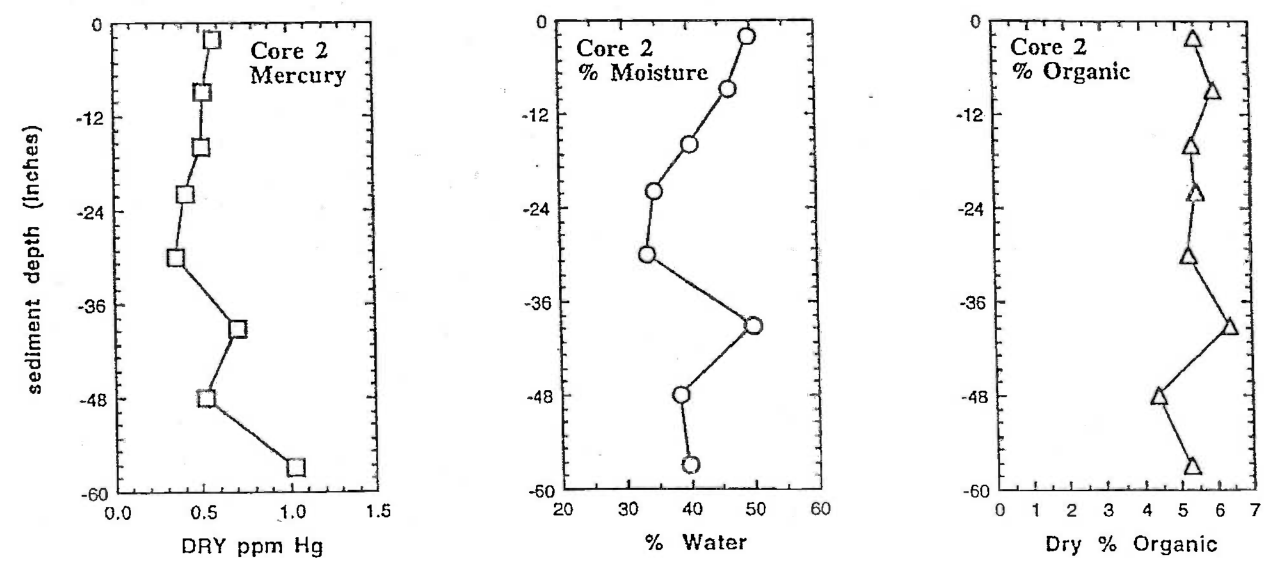


Figure 20. Marsh Creek Reservoir 1995 Sediment Core 2:
Western (Inflow) Basin Profiles



between 3.5% and 6.5%. This record indicates that, over the 30+ year history of Marsh Creek Reservoir, depositional sediments from the upper watershed remained fairly consistent in their character. In fact, with the exception of the 1.5 ppm mercury value at approximately 3 foot depth in the core, the mercury levels in this sediment were remarkably uniform, at 0.53-0.80 ppm. It is interesting to note that the underlying soil was significantly lower in mercury, at 0.24 ppm.

Core 2, from the western basin of the reservoir, was taken to a similar depth of approximately 5 feet (Fig. 20). However, in this core we were not able to reach an underlying terrestrial layer. This was apparent both visually and in the laboratory parameters. Color varied between light gray through black zones throughout the core, including the bottom layers. Texture varied between clays, silts, and sands throughout, all of which are depositional materials. Moisture and organic contents did not show a notable change at the bottom. Moisture varied between 33% and 50% throughout the core, while organic percentage ranged between 4.4% and 6.4%.

Similar to Core 1, mercury concentrations in Core 2 were very steady at 0.36-0.71 ppm, with a higher excursion to 1.03 ppm near the 5 foot depth. These levels are similar to concentrations found in earlier sampling from this basin of the reservoir. Levine-Fricke conducted limited sediment core work near the inflowing delta in October 1993, taking 10 replicate samples of surficial delta sediment and 10 replicate samples from approximately 3 foot depth in the sediment (Levine-Fricke 1993b). Mercury concentrations from that sampling ranged between 0.12 and 0.40 ppm (mean = 0.23 ppm) in the surficial sediment and between 0.24 and 0.48 ppm (mean = 0.35 ppm) in the samples from 3 foot depth. Our Core 2, taken at the center of the western basin from a boat, was presumably composed of smaller grain-sized deposition as compared to delta deposits. The somewhat lower mercury results in the delta samples may be partly a function of grain size. We have found that, similar to other metals, mercury concentrations in particulate depositional material typically rises exponentially with decreasing grain size (Slotton and Reuter 1995).

The slight historic increase at 5 foot depth in Core 2 may correspond to the 1.5 ppm mercury spike seen in Core 1 at 3 feet. As Core 2 was taken near the inflow from Marsh Creek, it would be expected to receive greater vertical accumulations of depositional material than the (offset) eastern basin. This is where the bulk of the heavier particles will fall out of the current, upon reaching the still waters of the reservoir, in the natural process of delta formation. Significant layers of fine to medium sand were indeed present in Core 2. This, in fact, is what limited the depth to which we could drive the core. Because the depositional rate at this site was greater than in the east basin clays/silts, the mercury increase at 5 feet could easily correspond to the peak seen at 3 foot depth in Core 1. In any case, mercury levels in both of the core profiles fell within a quite narrow range of concentrations.

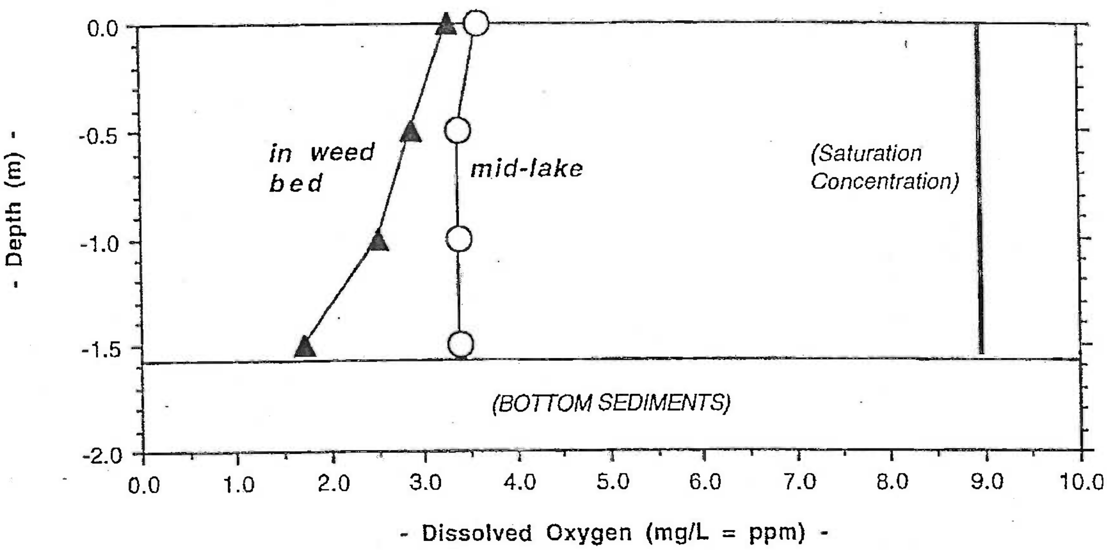
The similar mercury levels found across the 32 year reservoir depositional sediment record are consistent with the upstream mine having remained in a similar state of mercury loading to the watershed throughout this period. Another conclusion to be drawn from the uniform depositional mercury levels is that the construction of the settling basin beneath the mine tailings in ~1980 has apparently not resulted in a significant decrease in depositional mercury in the downstream reservoir.

3.2.2 Reservoir General Limnology

In the course of sampling the reservoir with a variety of techniques, we were able to characterize the fish populations present, as well as the general limnology of the system. In the sediment core studies (section 3.2.1) we found that the reservoir has already filled in with depositional sediment to a depth of approximately 5 feet. At the time of our reservoir work (September 1995), the resulting water column was found to be quite shallow throughout, with depths of 6 feet or less. Consequently, aquatic macrophytes (large aquatic plants) have been able to establish dense weed beds over large areas of the reservoir. The genus *Potamogeton* dominated at this time, with a dense fringe of cattail (*Typha*) and bullrush (*Scirpus*) around the margins. The water was quite turbid, with a Secchi visibility consistently under 0.5 m (< 20 inches). The turbidity was apparently largely due to brown, organic staining of the water.

While the dense weed growth will produce oxygen during the day it, together with general organic metabolism, will consume oxygen during dark hours when photosynthesis ceases. We took early morning oxygen and temperature profiles through the water column on a mid-September date to investigate the potential for significant oxygen depletion in the reservoir water (Fig. 21). Temperature at this time was very uniform at 20.9-21.5 °C (69.6-70.7 °F), indicating no appreciable thermal stratification. Indeed, during the previous night, strong breezes had stirred the waters of the reservoir. Despite being well mixed and uniform at the midlake, open water location, morning oxygen levels were quite low from surface to bottom, at approximately 3.5 ppm. This was only 39% of the normal solubility (saturation) level for oxygen at this elevation and water temperature (8.9 ppm). Within a representative aquatic weed bed, oxygen was at a similar level near the surface (3.2 ppm), while concentrations dropped steadily toward the bottom, to a level of 1.7 ppm, or 19% of normal solubility. Most fish cannot live under extended periods with oxygen below approximately 1-2 ppm (Moyle 1976). It is very likely that during mid-summer, with greater temperatures, increased biological respiration rates, and calmer weather, extensive anoxia may be a routine condition, particularly in the bottom waters of the reservoir.

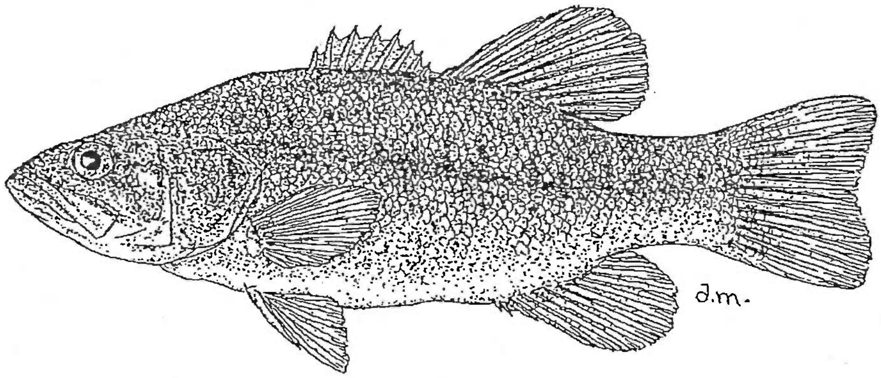
Figure 21. Marsh Creek Reservoir Dissolved Oxygen Profiles
(September 17, 1995; early morning profiles)



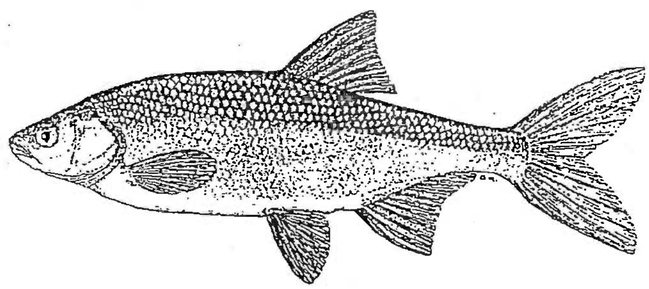
This finding of potentially prohibitively low oxygen occurrences is consistent with the variety of fish species found to inhabit the reservoir at this time. No bottom dwelling fish were taken, despite repeated sampling efforts with a variety of gill nets and set lines that have proven quite effective in other systems. Common bottom fish that would otherwise be likely to occur include catfish and bullhead, native suckers, and carp. The absence of these fish in our sampling indicates either that they were never introduced or that they may be unable to maintain significant numbers within the bottom waters of the reservoir under current conditions.

Of the four fish populations that were found, all were midwater and surface species (Fig. 22). Fish of any significant size, in terms of angling, included hitch (*Lavinia exilicauda*), a native planktivore that reaches approximately 1.5 pounds and 14 inches, and largemouth black bass (*Micropterus salmoides*), a prized gamefish that can reach over 5 pounds. Hitch inhabited the open areas of the reservoir in fairly abundant numbers, while the bass mainly stayed in open channels among the weed beds. Juvenile bass were prevalent, in addition to moderate numbers of adult bass in a range of sizes and ages. The

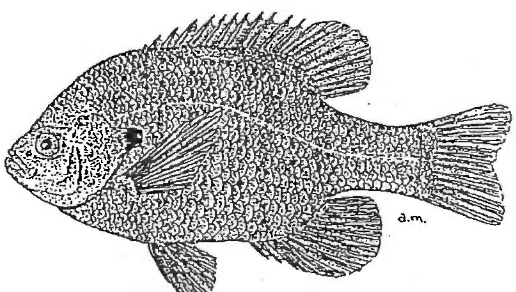
Figure 22. Marsh Creek Reservoir Fish Species Sampled in 1995
(illustrations taken from Moyle 1976)



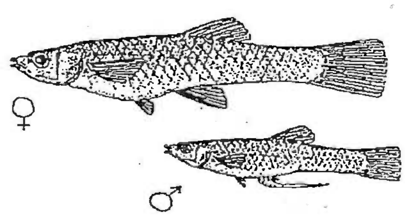
Largemouth Black Bass
Micropterus salmoides
(11-16 inches)



Hitch
Lavinia exilicauda
(10-13 inches)



Bluegill
Lepomis macrochirus
(to 8 inches)



Mosquito Fish
Gambusia affinis
1-2 inches)

other two fish species included mosquito fish (*Gambusia affinis*) and bluegill sunfish (*Lepomis macrochirus*). The surface-feeding mosquito fish were numerous at the shoreline and within the weed beds. These are very small fish, generally under 2 inches in length. The bluegill population was fairly dense and was characterized by stunted growth; i.e. a large number of very small fish. This is a frequent competitive outcome for bluegill in small, shallow water bodies (Moyle 1976). We only sampled a single bluegill of a size likely to be kept by anglers (8 inches, 1/2 pound). The great majority of bluegill were under 5 inches in length. We conclude that, under current reservoir conditions, adult largemouth bass are likely to be the only fish potentially sought for and taken by anglers.

The results of this 1995 fish assessment, as compared to that by the California Department of Fish and Game in 1980, differ in that redear sunfish and catfish were noted in 1980 but not in 1995 (Contra Costa County 1994). Additionally, the bass in the reservoir were reported to be smallmouth black bass in 1980, whereas they were clearly largemouths in 1995. This may reflect either a change in populations due to stocking or, more likely, an earlier misprint.

3.2.3 Reservoir Biota Mercury

A key component of this project was to assess the current levels of mercury contamination in Marsh Creek Reservoir biota, with the primary focus being fish within the range of sizes and types likely to be taken by anglers. For our assessment, we kept 10 "keeper" largemouth bass in a variety of sizes and ages for analysis. We also took 14 adult hitch, 1 large bluegill, and a range of additional biota samples that provide data comparable to other mercury work conducted throughout the state by our research group at the University of California and by state agencies.

In Table 11, the muscle mercury concentrations from sampled adult reservoir fish are presented, together with weight and length data. Liver mercury was also analyzed from a subset of the fish. The muscle mercury results are plotted graphically against fish size in Fig. 23. For both of the larger species, hitch and largemouth bass, muscle mercury levels demonstrated typical patterns of increasing mercury concentrations with increasing size/age of fish. Hitch, within the range of adult sizes common in the reservoir, varied in muscle mercury concentration from approximately 0.3 ppm at 0.6 pounds to approximately 0.5 ppm at 1.0 pounds. Adult largemouth bass muscle mercury ranged from just over 0.6 ppm at 1 pound to approximately 1.0 ppm at 3 pounds. These relationships were quite consistent across the 14 adult hitch and 10 adult largemouth bass sampled in this work. The single sampled bluegill individual that was potentially of angling size had muscle mercury at 0.63 ppm, intermediate between the adult hitch and adult largemouth bass levels. As hitch consume low trophic level foods (primarily algae and zooplankton), they will generally accumulate less mercury than the piscivorous (fish eating) largemouth bass. The bluegill diet consists mainly of small invertebrates, which are trophically intermediate relative to the diets of the other two species.

Table 11. Marsh Creek Reservoir Adult Fish Tissue Mercury Concentrations *(fresh/wet weight ppm Hg)*

	Weight *(g)*	Length *(mm)*	Muscle Hg *(wet wt ppm)*	Liver Hg
Hitch				
	285	266	0.26	0.33
	298	280	0.37	
	310	270	0.31	
	313	283	0.33	
	346	292	0.50	
	350	290	0.46	
	350	301	0.41	
	370	295	0.48	
	380	303	0.41	
	402	309	0.48	
	406	316	0.47	
	420	310	0.55	
	437	301	0.43	0.45
	480	322	0.48	
Bluegill				
	215	196	0.63	0.77
Largemouth Bass				
	412	283	0.64	0.55
	480	295	0.66	
	560	302	0.59	
	815	348	0.86	
	870	344	0.71	0.36
	930	343	0.72	
	1,030	372	0.84	
	1,040	362	0.90	0.58
	1,160	387	0.92	
	1,155	403	1.04	1.21

The U.S. FDA health standard for mercury in fish flesh is 1.0 ppm. However, the criterion recommended by the U.S. Academy of Sciences, the California Department of Health Services, and the great majority of other nations internationally is 0.5 ppm (TSMP 1990). In Fig. 20, the reservoir fish muscle mercury concentrations are compared to the 0.5 ppm criterion. The levels clearly straddle the line, with the "keeper" sized bluegill and largemouth bass all being well above the 0.5 ppm level. The bass ranged up to and even

Figure 23. Mercury Concentrations in Adult Fish From Marsh Creek Reservoir *(fish collected September 1995)*

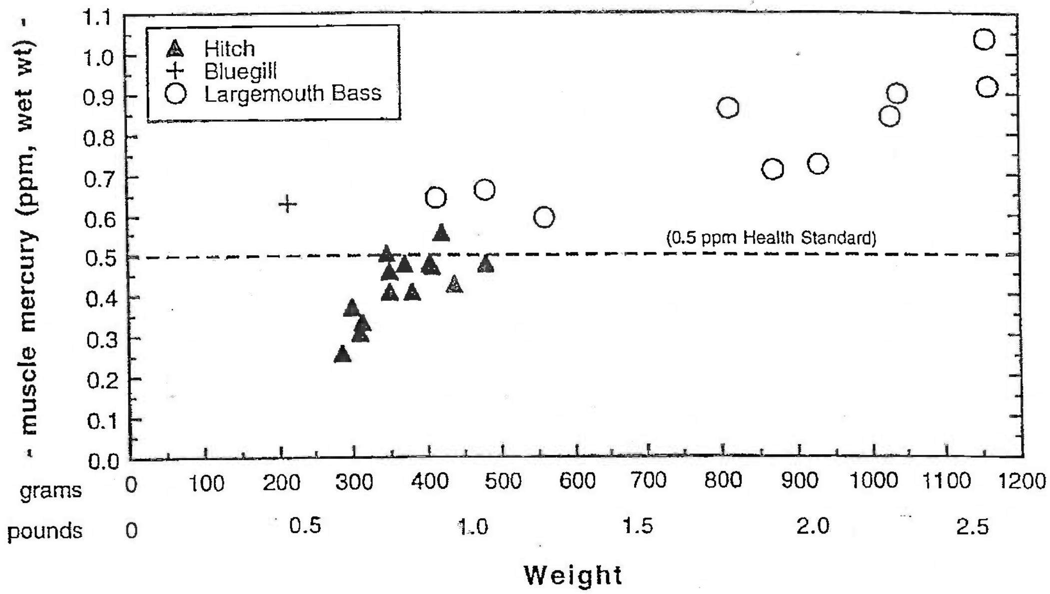
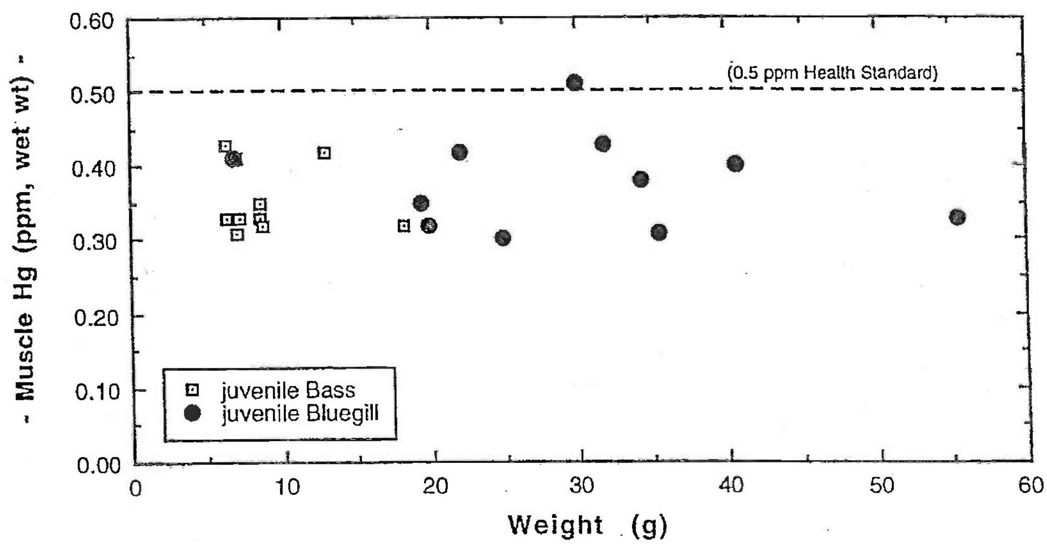


Figure 24. Mercury Concentrations in Juvenile Fish From Marsh Creek Reservoir *(fish collected September 1995)*



above the FDA 1.0 ppm standard in the larger individuals. These concentrations are clearly high. However, while of concern, they are not exceptionally high for this region of California, where mercury contamination is widespread. In our own research and that of other institutions and government agencies, similar levels have been reported from other water bodies directly impacted by mercury mines, including Lake Nacimiento and Lake Herman (TSMP 1990). Depending on the characteristics of the lake, some mine impacted sites have lower fish mercury levels, such as Clear Lake (Suchanek et al. 1993, Slotton et al. 1996), while others have higher levels, such as Davis Creek Reservoir north of Lake Berryessa (Reuter et al. 1989, Slotton et al. 1995b) and the small reservoirs near the New Almaden mine (TSMP 1990). Fish mercury levels nearly as high as those in Marsh Creek Reservoir can also be found in a number of the Sierra Nevada foothill reservoirs which have trapped mercury dating from the gold mining era of the 19th century (TSMP 1990, Slotton et al. unpublished data).

The muscle mercury concentrations in Marsh Creek Reservoir fish in 1995 can thus be considered to be too high for regular consumption, but not exceptionally high for northern California. An important consideration is that the levels were close enough to the health criteria that, if bioavailable mercury in the reservoir could be lowered by a significant fraction, future reservoir fish might be brought well under the guideline levels.

In addition to the large fish, we collected extensive samples of juvenile bass, juvenile bluegill, mosquito fish, and reservoir invertebrates. These types of samples will be extremely useful as bioindicators of potential year-to-year changes in mercury bioavailability in the reservoir, in conjunction with any mitigation trials upstream at the Mt. Diablo mine and/or in the reservoir itself. While the "bottom line" test of effectiveness for mitigation work will ultimately be determined by significant declines in muscle (fillet) mercury in the larger, edible fish of the reservoir, the larger fish accumulate their mercury over several to many years time. Because of this, their mercury concentrations can change only slightly within time scales of a year or two, even with major changes in environmental mercury. They generally do not show significant corresponding changes in their tissue mercury levels until they have lived the greater proportion of their lives under the new conditions (Slotton et al. 1995b). A major research focus of the senior author over the past decade has involved working with alternate bioindicator organisms, supplemental to adult fish, to develop approaches that can determine changes in pollutant exposure at a much finer scale, in terms of both time and location. We are using some of those tools in this project, including the invertebrate work in the upper watershed and the juvenile fish and invertebrate work in Marsh Creek Reservoir.

The young-of-year bass and small bluegill will be particularly useful (Table 12, Fig. 24). Muscle mercury concentrations in these small fish were quite consistent across the range of sizes present, falling between 0.30 ppm and 0.43 ppm in all 10 of the sampled juvenile bass (mean = 0.36 ppm) and in 10 of the 11 sampled small bluegill (mean = 0.37 ppm). One bluegill was somewhat higher, at 0.51 ppm. Because the young-of-year fish can have only accumulated mercury in the year they are sampled, these consistent 1995 levels can be compared in future years to corresponding levels in new young-of-year fish, to determine relative changes in exposure.

Table 12. Marsh Creek Reservoir Juvenile Fish Muscle (Fillet) Mercury Concentrations *(fresh/wet weight ppm Hg)*

Juvenile Bluegill Muscle Mercury			Juvenile Largemouth Bass Muscle Mercury		
Weight *(g)*	Length *(mm)*	Hg *(ppm)*	Weight *(g)*	Length *(mm)*	Hg *(ppm)*
6.9	72	0.41	6.4	78	0.33
19.4	99	0.35	6.4	80	0.43
19.8	100	0.32	7.0	80	0.41
22.0	104	0.42	7.1	80	0.31
24.9	104	0.30	7.3	82	0.33
30.0	112	0.51	8.5	87	0.35
31.7	114	0.43	8.6	89	0.33
34.3	117	0.38	8.7	89	0.32
35.4	118	0.31	12.9	98	0.42
40.7	124	0.40	18.2	111	0.32
55.4	131	0.33			

In addition to the small fish muscle mercury samples, we made composite, whole body samples of young-of-year bass and mosquito fish (Table 13). These composites, grouped by size class for each species, provide additional measures of short term reservoir mercury bioavailability. They also can be compared to the composite small fish data generated in the watershed work (section 3.1.3). As seen for muscle, whole body mercury concentrations in the juvenile bass were very similar among the range of sizes present, at 0.23-0.29 ppm. The levels in whole body composites were somewhat lower than those analyzed in muscle tissue. This is frequently the case, as muscle is the major site of mercury accumulation in fish (Reuter et al. 1989, Slotton 1991, Suchanek et al. 1993, Slotton et al. 1996). The tiny mosquito fish were also consistent in their whole body composite mercury levels, at 0.15-0.20 ppm among the dominant range of sizes. A single much larger individual, potentially several years old, had anomalously higher mercury concentration, at 0.57 ppm.

Table 13. Marsh Creek Reservoir Biota Composite Samples (Whole) Mercury
(wet wt ppm Hg, fish; dry wt, invertebrates) September 1995

Identification	Weight	Length	Individuals	Hg
(g)	*(mm)*	In Comp.	*(ppm)*	
Juvenile Largemouth Bass	(6.9)	(78)	n=5	0.29
Whole Fish Composite Samples	(8.6)	(88)	n=3	0.26
" " "	12.9	98	n=1	0.24
" " "	18.2	111	n=1	0.23
Gambusia (Mosquito Fish)	(0.1)	(20)	n=62	0.20
Whole Fish Composite Samples	(0.2)	(30)	n=32	0.15
" " "	0.5	38	n=1	0.15
" " "	2.1	57	n=1	0.57
Predatory Invertebrate Composite Samples (*dry* weight ppm Hg)				
Coenagrionid Damselflies	(winged adults)		n=25	0.09
Aeschnid Dragonflies	(winged adults)		n=4	0.27
Libellulid Dragonflies	(winged adults)		n=2	0.39

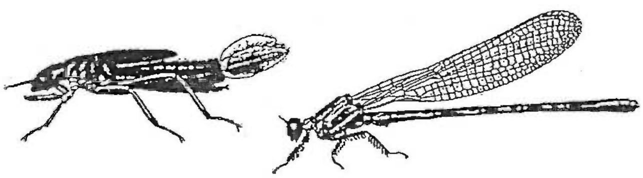
As final bioindicators of reservoir mercury, we took reservoir damselflies (Coenagrionidae) and two types of dragonfly (Aeschnidae and Libellulidae) in composite samples of winged adults (Table 13, Fig. 25). These were dried and powdered, similar to the watershed invertebrate samples. Damselflies and dragonflies are good indicators of reservoir conditions as they spend the majority of their lives in the aquatic stage, consuming other aquatic invertebrates, and continue to consume primarily reservoir-derived invertebrates even after becoming winged adults. The dragonfly composites contained 0.27 ppm mercury for one type and 0.39 ppm for the other. The smaller damselflies had a lower level of 0.09 ppm.

All of these samples provide initial baseline data of current mercury bioavailability in the reservoir. They can be compared to similar collections in future years, to determine the extent of potential changes in mercury availability.

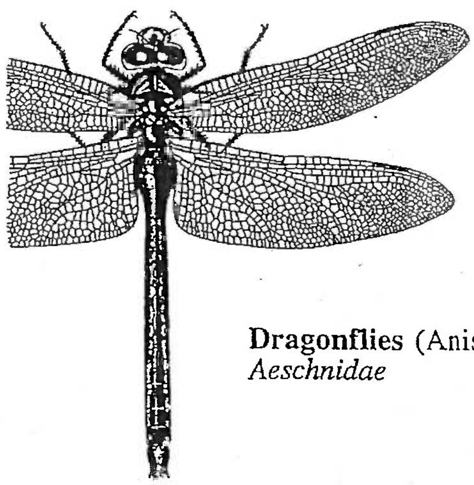
Figure 25. Marsh Creek Reservoir Invertebrates Sampled in This Project

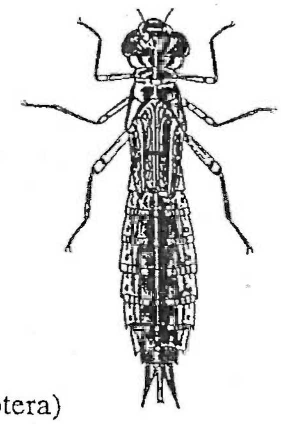
(winged adults taken, adults and aquatic stages shown)

(illustrations taken from McCafferty 1981)

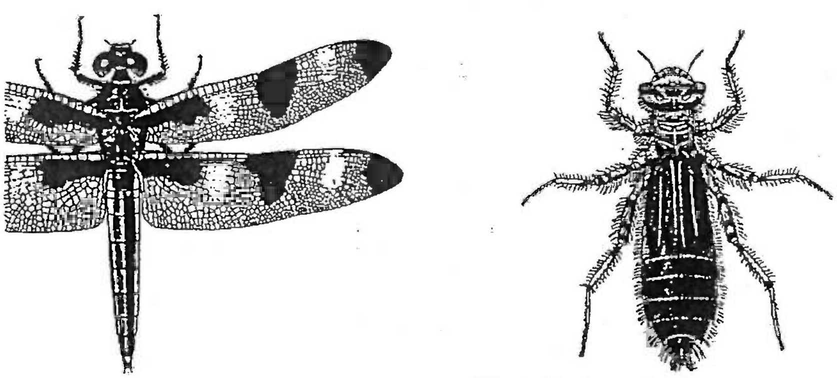


Damselflies (Zygoptera)
Coenagrionidae





Dragonflies (Anisoptera)
Aeschnidae



Dragonflies (Anisoptera)
Libellulidae

4. DISCUSSION AND CONCLUSIONS

Prior to this study, the Mt. Diablo Mercury Mine was generally assumed to be the dominant source of mercury to the Marsh Creek watershed. However, data was not available to quantify this input, rank the mine against other potential mercury sources, or rule out the possibility of a generalized source of mercury in this mercury-enriched watershed. Now, with the 1995 watershed mercury information assembled here, we can establish that the mine site does indeed represent the overwhelming source of mercury to the watershed. By collecting consistent, above detection aqueous mercury concentration data, together with accompanying flow information, from all major source areas, it has been possible to rank the various inputs on a mass balance basis. While the various loading values measured were specific to the particular flow regime during the sampling period, the relative contributions are of greater importance.

Both the aqueous mercury data and those from the invertebrate bioindicator organisms strongly implicate the mine region as being the dominant source of mercury in the Marsh Creek watershed. The aqueous mercury mass balance calculations indicate that approximately 95% of the total input of mercury to the upper watershed derives from Dunn Creek. The mine area itself was the clear source region for the mercury, with an estimated 88% of the total input of mercury to the upper watershed traceable specifically to the current exposed tailings piles. This is a remarkably high percentage, particularly in light of the geologically mercury-rich nature of the watershed in general, and indicates that the mercury in exposed, processsed, cinnabar tailings material is exceptionally available for aqueous transport downstream.

The data indicates that the great majority of the mercury load eminating from the tailings is initially mobilized in the dissolved state. This dissolved mercury rapidly partitions onto particles as it moves downstream. The bulk of downstream mercury transport is thus particle-associated.

In marked contrast to the massive mercury loads carried by lower Dunn Creek, this small tributary delivered less than 7% of the watershed's total flow and less than 4% of the suspended solids load. As downstream mercury accumulations are greatly dominated by the sediment burden, a lowering of mercury concentrations in the downstream surficial sediments would almost certainly help to drive down both the aqueous mercury concentrations and the corresponding flux of mercury into biota. With 95% of the mercury originating from the Mt. Diablo Mine area, but 95% of the watershed's suspended sediment load deriving from non-mine, low mercury source regions, any significant decrease in the export of mercury from the immediate mine site should result in a corresponding decline in surficial sediment mercury concentrations downstream and in Marsh Creek Reservoir. With an estimated 88% of the currently exported mercury linked directly to the tailings piles themselves, mercury source mitigation work within the watershed would clearly be best directed toward this localized source.

Though mitigation recommendations were not a part of our scope of work, we have several comments on the subject that may help to both clarify the task and direct the planning process:

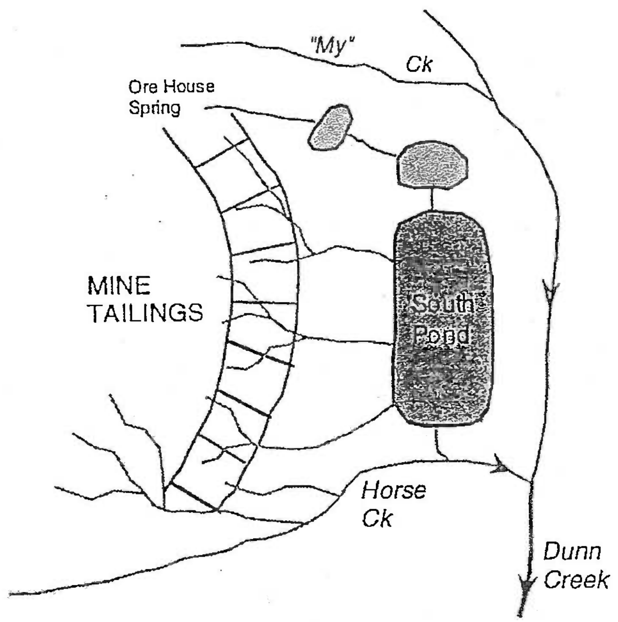
1. In order to reduce the downstream export of mercury from the Mt. Diablo Mercury Mine, we believe that the major mitigation focus should be directed toward source reduction from the tailings piles themselves, with subsequent containment of the remaining mobile mercury fraction being a secondary consideration.

2. The data we have assembled here indicate that source reduction of mobile mercury from the tailings will best be accomplished by diminishing the flow of water through the tailings. Rather than being a problem of direct erosion of tailings material, in solid particle form, to downstream, it appears that the predominant mode of mercury mobilization from the tailings involves the acidification of runoff/seepage water by the processed, high sulfur ore material, and the subsequent dissolution of mercury from the ore into the acidic water. Very similar trends are concurrently being found at the EPA Superfund site at Clear Lake's Sulfur Bank Mercury Mine.

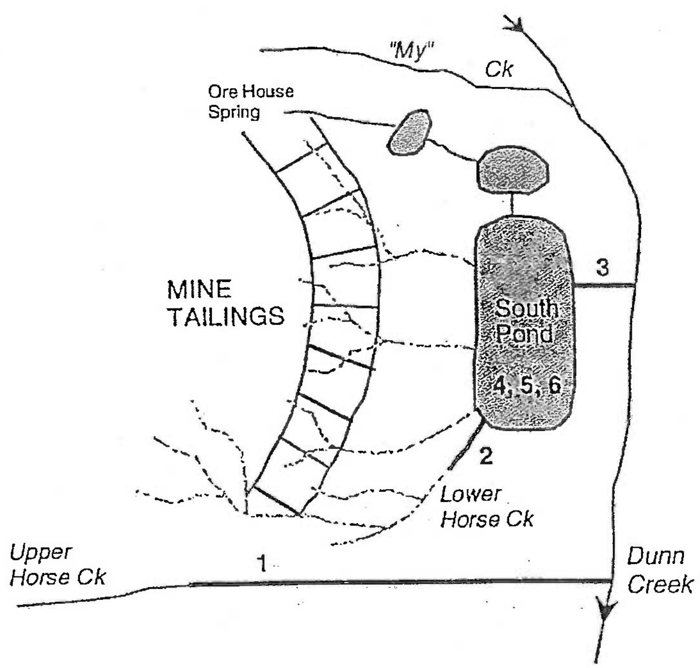
3. Lowering the flow of water through the tailings can be accomplished by (a) diverting any runoff that originates from outside of the tailings zone and (b) diminishing the movement of direct precipitation into and through the tailings. Diversion of upslope surface and groundwater flows away from the tailings will likely be the simplest and most cost-effective procedure to begin with. As part of this operation, upper Horse Creek should be diverted directly to Dunn Creek, bypassing the tailings (Fig. 26).

4. Direct water inputs to the tailings from precipitation are more problematical, but can be significantly lessened with a variety of revegetation schemes. Central to the most effective of these techniques is the application of a soil cover over the tailings that is sufficiently thick and porous to hold the average winter precipitation. Through the careful revegetation of the slope with appropriate, hardy plant species, much of this soil water can be annually soaked up and removed to the atmosphere through evapotranspiration. While grasses may be most efficient at initially stabilizing the slope, perennial shrubs and trees exhibit the greatest rates of evapotranspiration and

Figure 26. Current Mine Site Creek and Settling Pond Configurations vs Modification Options



a. Current configuration



b. Potential modifications

1. Pipe upper Horse Ck past tailings directly to Dunn Ck.
2. Divert lower Horse Ck into South Pond.
3. Construct new South Pond outlet on east side.
4. Deepen South Pond.
5. Periodically lime South Pond.
6. Periodically dredge South Pond.

have thus been found to be the most effective in removing accumulated soil water (Mary Ann Showers, California Department of Conservation, personal communication).

5. Any containment/treatment scheme for the remaining mobile mercury eminating from the tailings region will be enhanced by source reduction. Because the current principal sediment settling basin does not appear to be providing the desired level of effectiveness, we would suggest some modifications (also shown in Fig. 26):

   (a) As lower Horse Creek contained the majority of the mercury loads eminating from the tailings, it should be diverted into the pond.
   (b) Because much of the tailings inflow enters the pond near the southwest corner, the outflow should be relocated to a part of the pond distant from the inflow, i.e. to the east side of the pond. This will be even more essential if lower Horse Creek is diverted into the pond.
   (c) Consider deepening the pond, making more room for the deposition of precipitating solids and rendering them less susceptible to sediment resuspension.
   (d) Consider periodic liming of the pond to lower the acidity of the water and promote the rapid precipitation and deposition of dissolved metals.
   (e) Occasional dredging out of the accumulated depositional material may be necessary. This could be accomplished with minimal consequences to downstream by working in the dry season and temporarily sealing the outflow for the operation.

   Again, all aspects of secondary containment will be enhanced by source reduction of water, sediment, and associated mercury from the tailings.

Mercury in Marsh Creek Reservoir edible fish flesh was above the health standard concentration of 0.5 ppm in all samples of "keeper" sized bass and bluegill, with the larger bass ranging up to and slightly over 1.0 ppm muscle mercury. Fish accumulate mercury in their muscle (fillet) tissue almost entirely in the methyl form. Methyl mercury is naturally produced from inorganic mercury mainly as a metabolic byproduct of certain bacteria (Gill and Bruland 1990). As methyl mercury was measured to be quite low in storm runoff inflows to the reservoir (0.20 ng/L, Table 4), it is likely that a significant proportion of the methyl mercury accumulating in Marsh Creek Reservoir fish is produced within the reservoir from inorganic mercury associated with depositional sediments. Any lowering of the reservoir depositional sediment mercury concentration, through upstream mine site mitigation work, should act to reduce the rate of mercury methylation in the reservoir.

warranted, it may be possible to further reduce mercury methylation rates within the reservoir through water column manipulation to minimize anoxia. This is an area that we are currently investigating in our mercury biogeochemical research work.

With this 1995 watershed mercury assessment, a comprehensive, accurate data base has been initiated for the County, describing mercury conditions throughout the major components of the system. This includes mercury concentration, loading, and relative mass balance data for water and suspended sediment from all major tributaries, biota mercury levels from throughout the watershed, and depositional sediment and biota mercury concentrations from Marsh Creek Reservoir. The utility of these data for use as a general baseline could be substantially increased with the sampling of selected parameters in the current water year (1996), prior to any mitigation work, to help account for natural inter-annual variability. We note that 1995 was an extremely wet, high-runoff year, while 1996 is more of an average water year. It is our strong recommendation that the County obtain as extensive and varied a baseline data record as possible prior to mitigation, and maintain selective monitoring of key sites and parameters throughout and following mitigation work. Ongoing monitoring of carefully chosen indicator samples, both at the mine and in downstream receiving waters, will play an integral role in guiding and assessing the effectiveness of any mitigation efforts.

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EXHIBIT 17

THIS AGREEMENT, entered into this 1st. day of November, 1954, between MT. DIABLO QUICKSILVER COMPANY, LTD., a Nevada corporation, hereinafter referred to as "Lessor", and CORDERO MINING COMPANY, a Nevada corporation, hereinafter referred to as "Lessee",

W I T N E S S E T H:

WHEREAS, Lessor is the owner of the following described mine and mining property, together with all appurtenances:

DESCRIPTION:

The northeast quarter of the southeast quarter of Section 29 and the south half of the southwest quarter of the northeast quarter of Section 29, Township 1 North, Range 1 East, Mount Diablo Base and Meridian, containing 60 acres, more or less;

EXCEPTING THEREFROM: "That certain syphon pipe leading therefrom to a water trough on the northeast quarter of the southeast quarter of said Section Twenty-nine (29), which said water spring, trough, and pipe are excepted from this deed," as provided for in the deed from Edward A. Howard and Daisy B. Howard, his wife, to Mount Diablo Quicksilver Company, Ltd., a corporation, dated December 29, 1933, and recorded Feb. 1, 1934 (File No. 1060);

And

The northwest quarter (N.W.1/4) of the southeast quarter (S.E.1/4) of Section 29, in Township 1 North of Range 1 East, Mount Diablo Base and Meridian. Said property shall not include the following described property, to wit: that land beginning at the northwest corner of the northwest quarter of the southeast quarter of Section 29, Township 1 North, Range 1 East, Mount Diablo Base and Meridian; thence running southerly along the dividing line between the northeast quarter of the southwest quarter and the northwest quarter of the southeast quarter of said Section 29, a distance of 20 chains to the southwest corner of the northwest quarter of the southeast quarter of Section 29; thence running along the southerly line of the northwest quarter of the southeast quarter of Section 29, a distance of 2.924 chains; thence leaving said line, and running in a northerly direction, a distance of 20.23 chains to the point of beginning.

EXCEPTING from the demised premises the house known as the Blomberg house together with the right to use such water as is necessary for domestic purposes. In the event the option to purchase is exercised then this exception will be without effect and title to the Blomberg house shall pass with the other property.

IN ADDITION Lessee shall have the right to any access road over which Lessor has control.

And

WHEREAS, the Lessee desires to lease and to acquire an option to purchase the whole of said mining property above described, which the Lessor is willing to grant upon the terms and subject to the conditions hereinafter set forth,

NOW, THEREFORE, in consideration of the premises and the sum of One Dollar ($1) paid by the Lessee to the Lessor, receipt of which is hereby acknowledged, the Lessor hereby grants and leases to Lessee the above-described property for the purpose of investigating, exploring, prospecting, drilling, mining, producing, milling, and removing ores, metals, minerals, and values of every kind, and for the purpose of erecting thereon mills, plants and other structures in connection with said purposes, for the term of Ten (10) years from the date hereof with right to renew, upon a sixty (60) day prior written notice to Lessor, for an additional Ten (10) years on the same terms, including the right to apply payments made during the first Ten (10) years on the purchas price if said option to purchase is exercised during the second ten (10) years. These rights shall remain in effect during the period of the lease unless sooner terminated as hereinafter provided.

In consideration of said lease, IT IS HEREBY MUTUALLY

AGREED AS FOLLOWS:

1. <u>RENTAL AND ROYALTY:</u> The Lessee shall pay to the Lessor monthly, as rental for said property, a percentage of the proceeds resulting from the operation of said property by Lessee. This percentage shall be ten per cent (10%) of the money received for ores, metals, minerals, and values mined, saved and sold <u>less</u> freight, insurance, and brokerage, or Two Hundred Dollars ($200) per month, whichever is greater.

Unless notified as hereafter set forth, Lessee shall sell all flasks of quicksilver produced from the premises; provided, however, that Lessor shall have the option to receive the percentage royalties in kind, i.e. in flasks of quicksilver -- upon Lessor's giving Lessee a ninety (90) day prior written notice of exercise of such option. Similarly Lessor shall have the option by such a 90-day notice to have Lessee resume the sales of all production. Delivery in kind to Lessor shall be f.o.b. the mining property. Lessee agrees to store for Lessor's account any production taken by Lessor as royalty in kind without charge -- title, however, to such flasks of quicksilver for delivery in kind shall be deemed to pass to Lessor at the time Lessor receives royalty statements therefor from Lessee (for insurance and other purposes). Lessee shall supply Lessor with full and complete supporting data with regard to deliveries in kind.

2. <u>OPTION:</u> The Lessor shall and does hereby give and grant unto the Lessee the sole, exclusive and irrevocable right and option to purchase and acquire the whole of the said mining

property above described, upon the payment of the option price, on or before the termination of this lease, and any renewal, and in the manner and upon the due performance of the covenants to be kept and performed by the Lessee, all as herein provided.

3. <u>PURCHASE PRICE</u>: The Lessee, upon the exercise of said option, shall pay the Lessor as a total purchase price for the above-described property, the sum of One Hundred Seventy Thousand Dollars ($170,000) lawful money of the United States of America. All rental and royalty payments made to Lessor hereunder shall be credited on the purchase price. The balance of the purchase price shall be paid in full upon the exercise of said option and delivery of a good and sufficient deed as herein provided.

For the purpose of crediting royalty payments on the purchase price, in connection with deliveries in kind, the credits shall be based upon the average proceeds per flask sold by Lessee in the particular month involved; provided, however, that if no sales are made by Lessee during any such month, royalty payments as well as credits on the purchase price shall be determined by taking the average of the weekly low quotations for the particular month as set forth in the E. & M. J. Metal and Mineral Markets Magazine (<u>less</u> freight, insurance and brokerage); provided further, that such method shall be applied for the purpose of computing royalties or for any other purpose applicable to the provisions of this agreement.

4. <u>MANNER OF PAYMENT</u>: The royalty payable to Lessor hereunder, shall be payable in monthly installments commencing

on the 15th day of December, 1954, and continuing on the 15th day of each and every month thereafter until the expiration of the term hereof or the earlier termination of this lease. Royalty payments shall be based on receipts from sales of the previous month, on the basis provided for in Paragraph 1 above. Notwithstanding anything to the contrary contained herein, it is agreed that each monthly installment shall be not less than Two Hundred Dollars ($200). The Lessee shall transmit with the royalty check a full and true statement of the production and sales receipts of the previous month. A representative of the Lessor shall at all times have the right during regular business hours to examine the underground operations and the furnace plant.

5. MINING METHODS AND CONDITIONS: Lessee shall be sole judge as to methods of mining and milling, what constitutes ore, when and if ore is extracted or milled and all other phases of operating the property. All operations conducted by the Lessee upon the property shall be performed in accordance with the laws and regulations of the United States and the State of California and in accordance with good practices in workmanship, mining and milling, particularly with regard to the safety and welfare of workers. The Lessee shall at all times during the existence of this lease maintain a watchman on the premises.

6. POSSESSION: Lessee, its agents, representatives or employees may enter in and upon and take possession of the whole or any part of the property above described, at once; and, may then and there commence any work to explore or mine the property,

in keeping with the tenor of this agreement, that it may deem advisable, and for that purpose, may use any buildings, equipment or mining facilities which may now be situated on the premises, and owned by Mt. Diablo Quicksilver Company, Ltd., with the exception of that certain house noted in the above description of the premises.

The Lessee may use, in working on the demised premises, all supplies now on the demised premises, but, in the event he should remove or dispose of said supplies otherwise than in developing the demised premises, he shall pay the Lessor the reasonable value thereof. During the term of this lease the Lessee may use all tools, machinery and equipment of the Lessor now on the demised premises for the purpose of developing the same and operating and maintaining the same, and shall have the privilege of replacing or remodeling the same, and any structures on the demised premises. An inventory enumerating such tools, machinery or equipment and structures, is attached hereto, marked Exhibit "A" and made a part hereof. Lessee shall maintain the same and replace any that are broken, damaged or worn out, normal wear and tear excepted. Such replacements shall become the property of the Lessor. At the expiration of this lease or in the event of the Lessee vacating the demised premises for any reason, Lessee may remove, as provided in Paragraph 14, any portable tools, machinery, or equipment which Lessee has placed upon the property, or any portable structures which Lessee may have placed upon the property, but Lessee may not remove any permanent structures or any repairs or replacements to units of equipment or machinery now on the property.

7. INDUSTRIAL INSURANCE: Lessee shall comply with the laws of the State of California for the protection of employees against injury and disease and, in that connection, shall save harmless the Lessor against any damage by reason of such claims. Lessee shall provide and maintain at Lessee's expense fire insurance and other appropriate casualty insurance on all of the structures, machinery, equipment and tools covering the full appraised insurable value thereof for the maximum protection of both Lessor and Lessee, as their interests may appear, and Lessee shall furnish to Lessor certificates of such insurance if required, and the same shall be subject to the approval of Lessor for adequacy of protection.

8. PUBLIC LIABILITY: Lessee shall save Lessor harmless from any liability for property damage, personal injury or death arising from the work, mining or acts performed by Lessee and its employees in connection with the lease and option.

9. LIENS: Lessee shall save Lessor harmless from all liens upon the property made or suffered by Lessee, and in that connection shall post the property in accordance with law, noticing owner's (Lessor's) non-responsibility, before commencing any work.

10. TAXES: Lessee agrees to pay, prior to delinquency, all taxes and assessments, including personal property taxes and

net proceeds of mine taxes, to State, County or School District, or any other government subdivision, with the exception of taxes on royalties paid to Lessor. Taxes shall be prorated as of the date hereof.

11. DEFAULT: Time shall be of the essence of this agreement. In the event of default of any of the payments or covenants herein contained, by Lessee, this lease shall terminate, at the option of the Lessor. If Lessor elects to terminate this agreement by reason of Lessee's default, Lessor shall serve notice of his intention by registered mail, or personal service upon Lessee or its duly authorized agent for service of process. Upon service of notice, Lessee shall have sixty (60) days in which to cure said default. If within said sixty (60) day period the default has not been cured, Lessor may terminate this agreement by giving Lessee notice of such termination, and at that time this agreement and all of the rights of Lessee hereunder shall terminate.

12. PURPOSE: This agreement is a lease and option only, and the Lessee shall have the right to surrender this contract and to discontinue any and all work and payments hereunder at any time, without liability therefor, upon giving Lessor thirty (30) days' prior written notice of intention to so terminate, except that Lessee shall be liable for royalties and amounts due and payable at the date of such termination. Upon demand after surrender, Lessee shall execute and deliver to Lessor a good and sufficient surrender and release of all rights hereunder.

Lessee shall control the discharge of water from the mine properties in such manner as not to pollute any of the wells on any of the adjoining property or the waters of Marsh Creek or Dunn Creek. Lessee is advised of that certain decision and order of the Water Pollution Control Board of the State of California, dated December 14, 1953, and Lessee agrees to comply in all respects with said order, as the same may be modified, amended or altered from time to time, and with any and all other orders, rules and regulations of any governmental authority in respect of discharge of water from the mine properties.

13. INSPECTION: The owner (Lessor) or his duly authorized agents or representatives shall have the right at all reasonable times to enter upon the said property and inspect the work conducted by the Lessee thereon, or records of the production of the mine.

14. REMOVAL OF EQUIPMENT: In the event of termination of this contract, by surrender or default as provided, the Lessee may, within a period of ninety (90) days thereafter, remove any and all machinery, power plant, equipment, building, track, tools, and supplies placed thereon by Lessee except as provided in Paragraph 6 above. In the event of termination Lessee shall provide Lessor with copies of any mine maps of this property which it may have.

15. ASSIGNMENT: Lessee shall not assign this lease or any interest therein and shall not sublease or underlet the premises, or any part thereof, or any right or privilege appurtenant thereto without the written consent of the Lessor -- and such consent shall not be unreasonably withheld. Notices required

hereunder shall be deemed to be completed when made in writing, deposited in the United States mail, registered, postpaid, addressed to

Lessor: MT. DIABLO QUICKSILVER COMPANY, LTD.
Clayton, California

Lessee: CORDERO MINING COMPANY
131 University Avenue
Palo Alto, California

16. On the exercise of the option herein granted to Lessee to purchase certain property, and the payment of the further purchase price therefor, as hereinabove provided, Lessor shall convey said property to Lessee by grant deed. There has been exhibited to Lessee, and Lessee is fully advised of, that certain preliminary title report of California Pacific Title Insurance Company on said property dated October 28, 1954 (Order No. 190821). It is understood and agreed that at any time after the expiration of three (3) years from the date hereof, or upon payment by Lessee to Lessor of one-half (1/2) of the said purchase price -- whichever event is earlier -- on demand by Lessee to Lessor, Lessor shall take such steps and commence such legal proceedings as it may be advised necessary to clear the title of said land of the exceptions appearing on said title report, and Lessor shall thereafter prosecute said proceedings with all reasonable diligence.

IN WITNESS WHEREOF, Lessor and Lessee have caused these presents to be executed by their officers thereunto duly authorized, the day and year first above written.

MT. DIABLO QUICKSILVER COMPANY, LTD.

By Vic Blomberg
Vic Blomberg
President

By Harold Blomberg
Harold Blomberg
Secretary

(Corporate Seal)

LESSOR

CORDERO MINING COMPANY

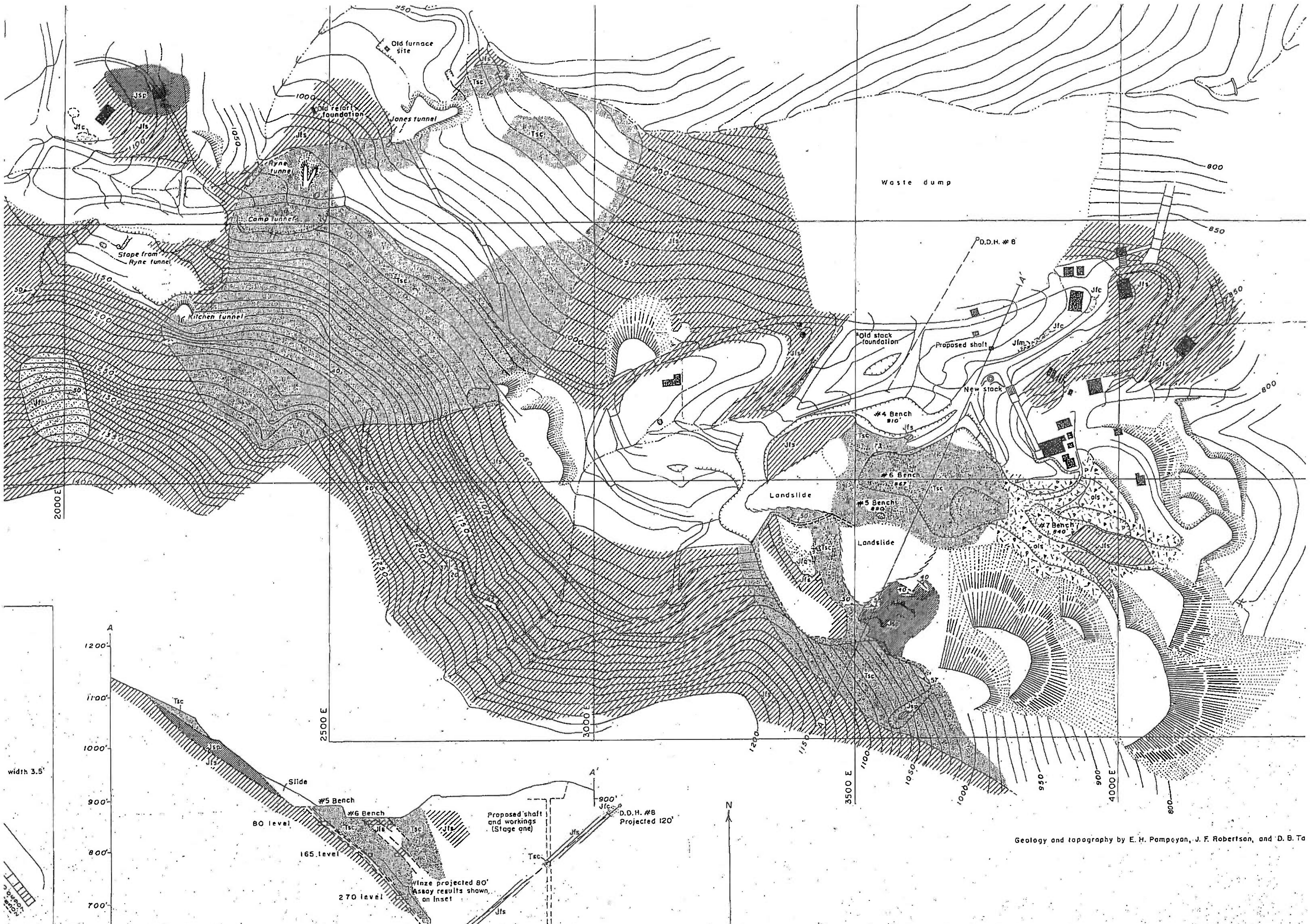
By S. H. Williston
S. H. Williston
Vice President

(Corporate Seal)

E. A. Williston
Asst. Secretary

LESSEE

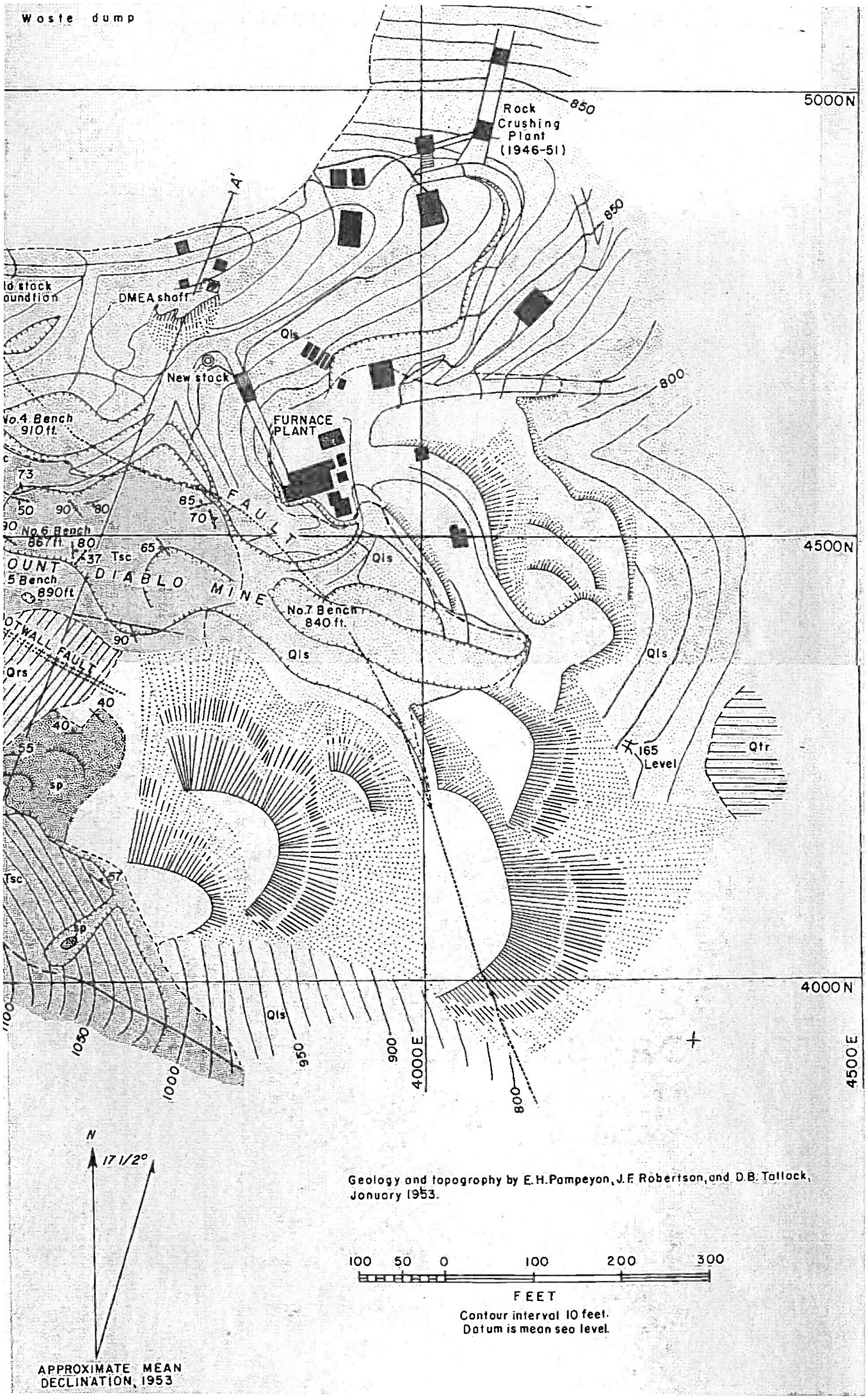
EXHIBIT 18



Geology and topography by E. H. Pampeyan, J. F. Robertson, and D. B. Ta

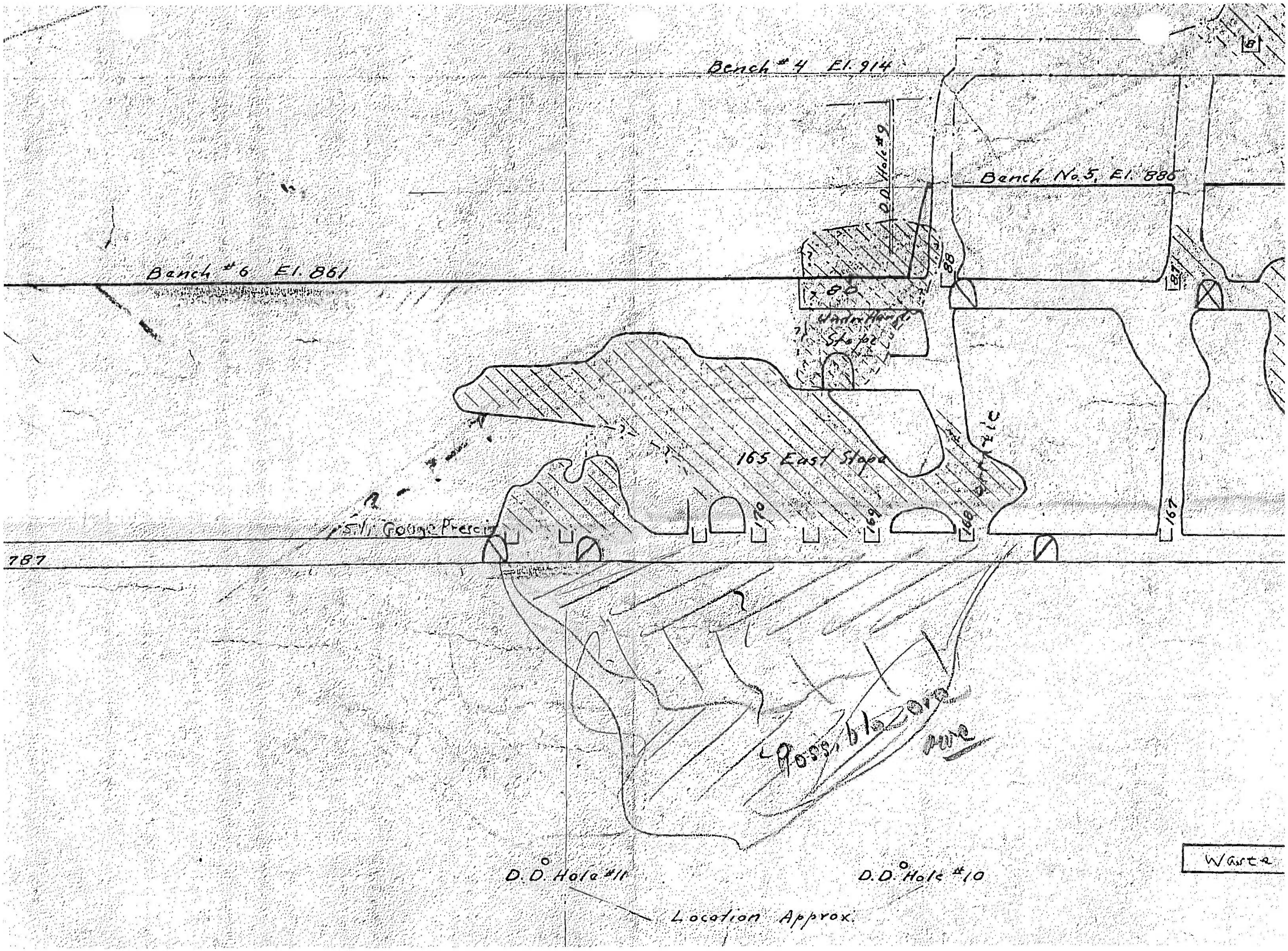
MOUNT DIABLO MINE, CONTRA C[illegible]TA COUNT

EXHIBIT 19



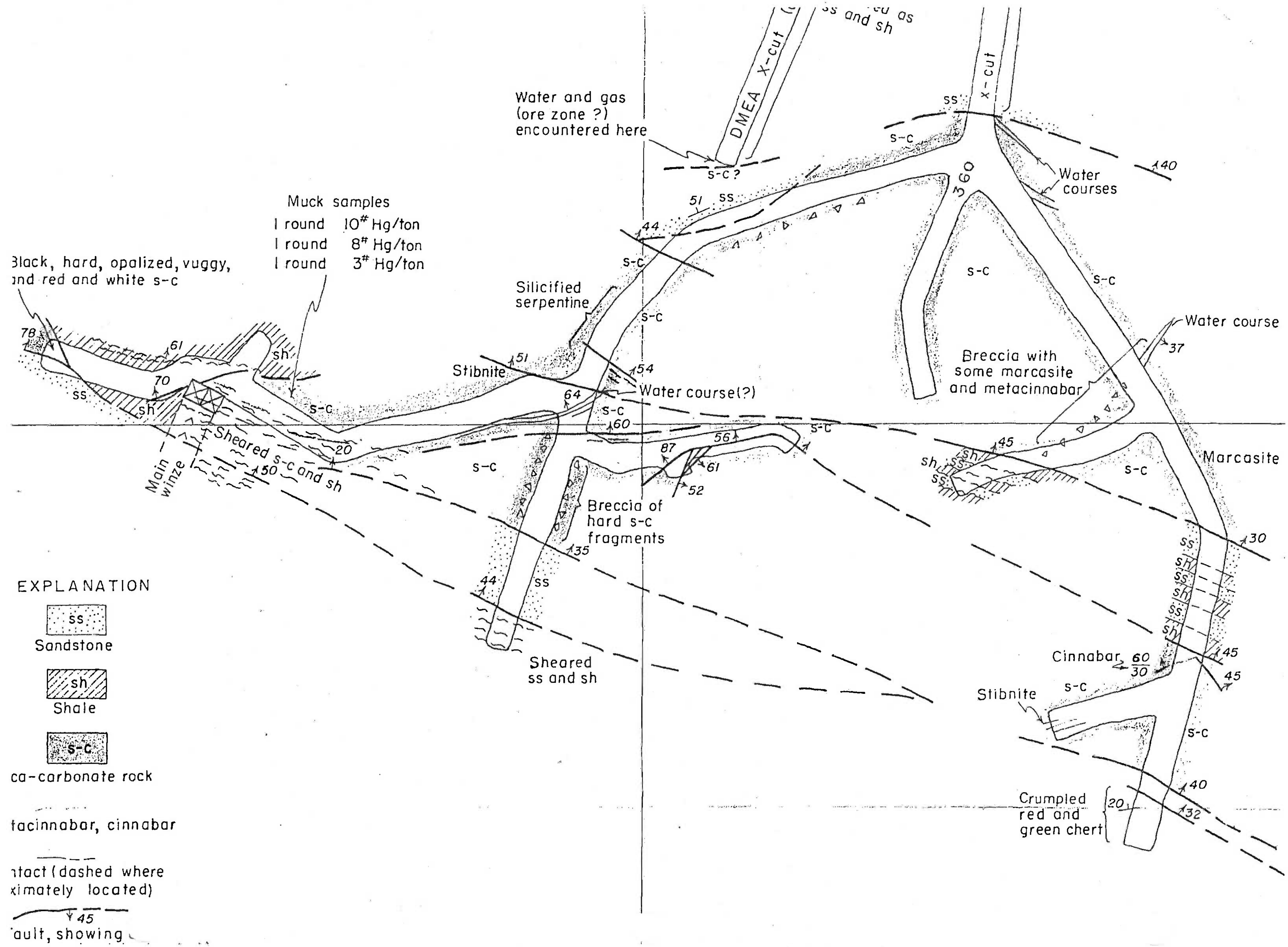
Waste dump
5000N
850
Rock Crushing Plant (1946-51)
A'
850
ld stack aundtion
DMEA shaft
Qls
New stack
800
No.4 Bench 910 ft.
FURNACE PLANT
73
50
90
80
85
70
FAULT
90
No.6 Bench 867 ft.
80
65
37
Tsc
Qls
4500N
OUNT DIABLO MINE
5 Bench 890 ft
No.7 Bench 840 ft.
OTWALL FAULT
90
Qls
Qls
Qrs
40
40
55
sp
165 Level
Qtr
Tsc
57
sp
4000N
1100
1050
1000
Qls
950
900
4000E
800
4500E
N
17 1/2°
APPROXIMATE MEAN DECLINATION, 1953
Geology and topography by E.H. Pampeyon, J.F. Robertson, and D.B. Tallock, January 1953.
100 50 0 100 200 300
FEET
Contour interval 10 feet.
Datum is mean sea level.

EXHIBIT 20



Bench #4 El. 914
D.D. Hole #9
Bench No.5, El. 880
Bench #6 El. 861
88
87
8
80
165 East Stope
170
169
168
167
787
Possible ore
D.D. Hole #11
D.D. Hole #10
Location Approx.
Waste

EXHIBIT 21



Water and gas
(ore zone ?)
encountered here
DMEA X-cut
ss and sh
x-cut
Muck samples
I round 10# Hg/ton
I round 8# Hg/ton
I round 3# Hg/ton
Black, hard, opalized, vuggy,
and red and white s-c
Silicified
serpentine
Stibnite
Water course(?)
Breccia with
some marcasite
and metacinnabar
Water courses
Water course
Marcasite
Main
winze
Sheared s-c and sh
Breccia of
hard s-c
fragments
Sheared
ss and sh
Cinnabar
Stibnite
Crumpled
red and
green chert
EXPLANATION
Sandstone
Shale
ca-carbonate rock
tacinnabar, cinnabar
ntact (dashed where
ximately located)
ault, showing