UNIVERSITY OF CALIFORNIA

DIATION LABORATORY
O. BOX 808
VERMORE, CALIFORNIA

August 22, 1967

Mr. E. C. Shute, Manager
San Francisco Operations Office
U.S. Atomic Energy Commission
2111 Bancroft Way
Berkeley, California

Subject: SUMMARY HAZARDS ANALYSIS - PU-AM RELEASE TO SANITARY SEWER

Dear Mr. Shute:

The attached summary analysis of the recent radioactivity release to the Livermore sanitary sewer system is enclosed for your information and a copy included for further transmittal to Mr. A. Cornish of the State Department of Public Health. Total distribution of this report is noted, with no further distribution anticipated.

The data, conclusions, and recommendations contained in this analysis were discussed on July 11, 1967 in a meeting at LRL with Mr. Bryce Rich, LRL Hazards Control; Messrs. A. Cornish and J. Brown, State of California Department of Public Health; and Mr. J. Beaufait of your office.

It is my understanding from this meeting that there was agreement with the conclusions and recommendations of this analysis report by all in attendance. On this basis, the Laboratory is continuing to accomplish the recommendations as noted. During the week of August 21, 1967 the Laboratory will meet again with Livermore officials to discuss final disposition of this matter.

If your office or the State Department of Public Health does not concur with the recommendations, we would appreciate your comments.

Sincerely,

DCS:WPB:j

D. C. Sewell
Associate Director
LRL, Livermore

Attachments:
Memorandum to D. C. Sewell. Subject: Summary Hazards Analysis - Pu-Am Release to Sanitary Sewer. Dated July 18, 1967 (2 copies)

ROOM 1515 [illegible]

OFFICIAL USE ONLY

June 29, 1967
BLR-38-67

MEMORANDUM

TO: D. C. Sewell

FROM: W. P. Bennett and B. L. Rich

SUBJECT: Preliminary Hazards Analyses - Pu-Am Release to Sanitary Sewer

Introduction

During the three week period of May 25 through June 15, approximately 32 millicuries of Pu 239 - Am 241 was released from an unidentified Laboratory location into the sanitary sewer system. Although the maximum permissible levels (AEC Manual Chapter 0524) for uncontrolled drinking water had not been exceeded at any time, a vigorous sampling program at the Livermore Sewage Treatment Plant was initiated to better define concentrating mechanisms, hazards, etc. The appropriate city, state and AEC offices were notified as soon as the magnitude of the release was adequately verified in order to avoid misinterpretations of increased sampling programs and possible bad publicity from inadvertent release of partial truths, etc. The following summarizes our findings and evaluations to date.

LRL Sewer Monitor

The Laboratory maintains a "continuous" sampler on the sanitary sewage system which collects a proportional sample of sewage as it leaves the LRL and Sandia sites. The sampler takes a fixed volume sample at a frequency proportional to the volume of flow in the sewer. The sewage then enters the Livermore sewer system and goes directly to the waste treatment plant.

Three times a week a sample is collected from the sump in which the proportional sample is accumulated. The sample (containing solids, wastes, etc.) is evaporated, digested and plated on stainless steel planchettes for gross alpha and beta counting. Other specific analyses for tritium, iodine, beryllium, PH and chlorine are routinely run on the sample. When radioactivity in the sample is high, pulse height analyses for specific isotope identification is performed.

On May 25 and 29, the routine samples obtained from the sump and counted on May 29 and June 1 indicated approximately 30 and 100 times the "normal" levels respectively. The sewer monitor was inoperative during the period of May 29 to June 2. The sample obtained on June 6 was also a factor of 100 higher than "normal". (See Figure 1.) Isotopic analyses identified the contamination as Pu 239 and Am 241.

Livermore Sewage Treatment Plant

Samples of the digesters and sludge in the city sewage treatment plant are routinely analyzed once a month. Even though the Laboratory had not exceeded

one-half the maximum permissible drinking water levels recommended for continuous uncontrolled off-site use, an unusual release had occurred and an increased sampling frequency was initiated on June 6. Samples taken on June 6 in the digester were approximately 1 to 2 thousand times "normal". The activity was identified as Pu 239 and Am 241. It was estimated (from LRL sewer monitor analyses) that over a three week period from May 25 to June 15, the Laboratory discharged approximately 32 millicuries of Pu 239 - Am 241 to the sewer (see Figure 1). A reasonably detailed sampling program at the Livermore treatment plant revealed that there was approximately 27-30 mCi of Pu 239 - Am 241 in that system as of June 16 (see Table I). This is excellent agreement.

Analyses indicate that this activity tends to follow the plant "sludge", concentrating in the aeration tanks and sludge digesters (see Figure 3). The digester sludge is routinely discharged to the sludge lagoon where it is mixed with such large volumes of sludge that hazardous levels are not expected.

Levels in each of these systems are being maintained due to the concentrating mechanism of the digester and aeration tanks. 90% of the sludge from the secondary sedimentation tank is returned to the aeration tanks; the other 10% is pumped back to the "head end" of the system. This provides a concentration mechanism in the aeration tanks and tends to maintain a low level of activity throughout the system while the activity is being removed to the digesters. The digesters are a concentrating mechanism also. Since 0.5-2% of the sewage is solids with a density of approximately 1, the activity in the sludge is concentrated by a factor of 50-200.

Figure 2 indicates the expected clearance rate of the system which will be accomplished by purging with uncontaminated waste over a period of time.

It should be noted that nearly all the activity will eventually be contained in the sludge lagoon. The sludge is placed either in drying beds or in sludge lagoons, where the water is removed by evaporation and "decanting". The drying beds have not been used for the better part of a year. All of the radioactivity has gone to the sludge lagoons, which have a capacity of approximately 5 years at present plant volume. The ultimate fate of the sludge in the sludge lagoons is uncertain at this time. However, it is anticipated that it will be several years before it is used in turf building. The sludge is never used in agricultural areas (food production) unless specific public health service approval is granted.

Hazards Analyses

The radioactivity will be contained in a layer of sludge, i.e. beneath approximately 3-4 feet of sludge on the top with approximately 8-10 feet below. When the sludge is removed, some mixing would occur. However, assuming the activity is removed in as little as one-third of the solids from the lagoon and assuming

1.5 cf of sludge per m^2 of turf (worst feasible conditions), less than 0.5 uc/m^2 of turf would result. This compares to 4.5 uc/m^2 (MPC recommended by LRL) for use on deep root perennials. Levels as high as 62 uc/m^2 are recommended by the USAF* for uncontrolled surface contamination, such as the levels which would be permitted on the surface following a Palomares-type accident. A recommended decontamination technique of higher levels (same reference) in these areas consists of plowing to a depth of 1 foot.

Increased frequency sampling in the Livermore treatment plant area has been established and will be continued until all of the activity in the plant has reached the sludge lagoons. The present activity levels in the plant do not constitute a significant personnel hazard. Since nearly all the activity is contained in sludge and diluted in extremely large volumes, we estimate that there will be no significant uptake by plant personnel. Air activity levels have been and are being measured at the plant during the period of time when activity levels are the highest. No detectible ($< 10^{-14}$ uc/cc) activity has been found above natural background (most restrictive $MPC_a = 6 \times 10^{-14}$ uc/cc).

The effluent water from the plant has been analyzed daily since June 15. Activity was detected on 2 days only and indicated < 0.1 MPC_w for continuous uncontrolled drinking water (5×10^{-3} detection limit).

Available data indicate that there is little or no downward migration of plutonium in soils. There is no significant risk of the radioactivity in the sludge lagoons reaching the water table.

*"Nuclear Weapon Accident Program", Strategic Air Command (Offutt AFB, Nebraska), Report SACM-355-1, 7 Feb. 1964.

Source Location

An attempt has been made to locate the source of this accidental release within the Laboratory by sampling the plant sewer system at various points and surveying Laboratory drains and possible discharge points building by building. At present, the only indication of activity released is in the Decontamination and Disposal areas, Building 127. Since low level radioactivity is routinely released to the sewer from this area, it has not been definitely established that this is the source of the release in question. However, at present, it seems to be the most likely source. Increased controls, sampling techniques, etc. are being applied in this area to prevent inadvertent releases. Continued surveillance of other areas is being exercised.

Conclusions

1. During the period of May 25 to June 15, 1967, approximately 32 mc of Pu 239 - Am 241 was released to the Livermore treatment plant. This activity was contained in sewage effluent which when it left the Laboratory was at a concentration of $< 1/2$ the permissible drinking water limit.

2. This activity is now concentrated in the sludge within the treatment plant and will be diluted in specific activity when it is released to the sludge lagoons.

3. The clearance of the system may take several months (28 day half life) based on the most recent information on flow rates and volume.

4. The activity will become diluted, distributed and fixed in an approximately 2 foot thick layer of sludge.

5. There is no hazard to the plant personnel as a result of the presence of this material.

6. Insignificant activity ($< 0.1 \times MPC_w$ for any one day) has been released in the plant liquid effluent to the environment.

7. It is extremely improbable that levels exceeding 0.5 uc/m^2 could ever result in any area regardless of the fate of the activity in the sludge. This is below present acceptable standards of 4.5 uc/m^2 for deep root perennials.

8. Although this particular incident has not resulted in a release above permissible levels or presented a hazard to treatment plant personnel or the community, the concentrating mechanisms in this plant should be recognized for future hazards evaluations.

9. Our present monitoring system needs to be upgraded in order to reduce the long delay between release and detection of accidental releases of activity.

Recommendations

1. That no attempt be made to remove the activated material from the plant at this time, and that it be allowed to become fixed in the sludge lagoon.

2. That Hazards Control proceed with high priority to develop an adequate continuous monitoring (alarmed) system for the LRL sewage effluent.

3. That the detailed sampling program at the treatment plant continue at least until it is assured the activity has reached the sludge lagoon and until any activity released from the plant has been documented.

4. That we obtain concurrence with the above conclusions and recommendations from the California State Department of Health (Joe Ward) and this information be relayed to the proper City of Livermore officials.

5. When the improved system in item 2 above is in service, close coordination with plant personnel in case of future accidental releases should be exercised such that diversion of high level contaminated effluents to holding basins will minimize hazards and will aid in decontamination and/or removal (if necessary).

W. P. Bennett

B. L. Rich

WPB:BLR:as
Attachments

cc: R. V. Griffith
D. J. Kvam
J. L. Olsen
R. J. Patterson
R. E. Yoder

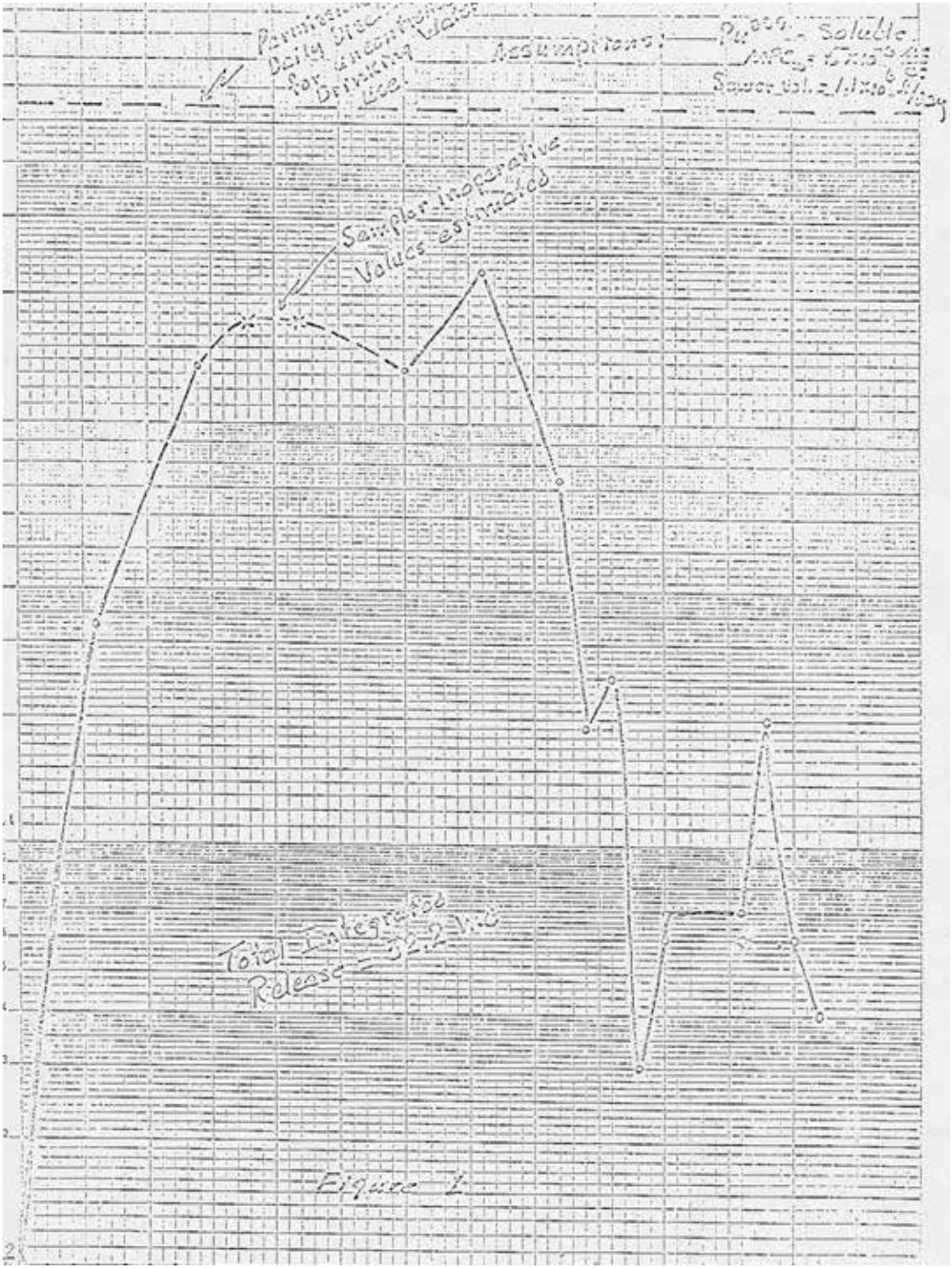

Permissible Daily Discharge for Unrestricted Drinking Water Use
Assumptions:
Pu239 - Soluble
Sewer Vol. = 1.1 x 10^6 gal/day
Sampler Inoperative Values Estimated
Total Integrated Release = 32.2 Ci

Figure 1

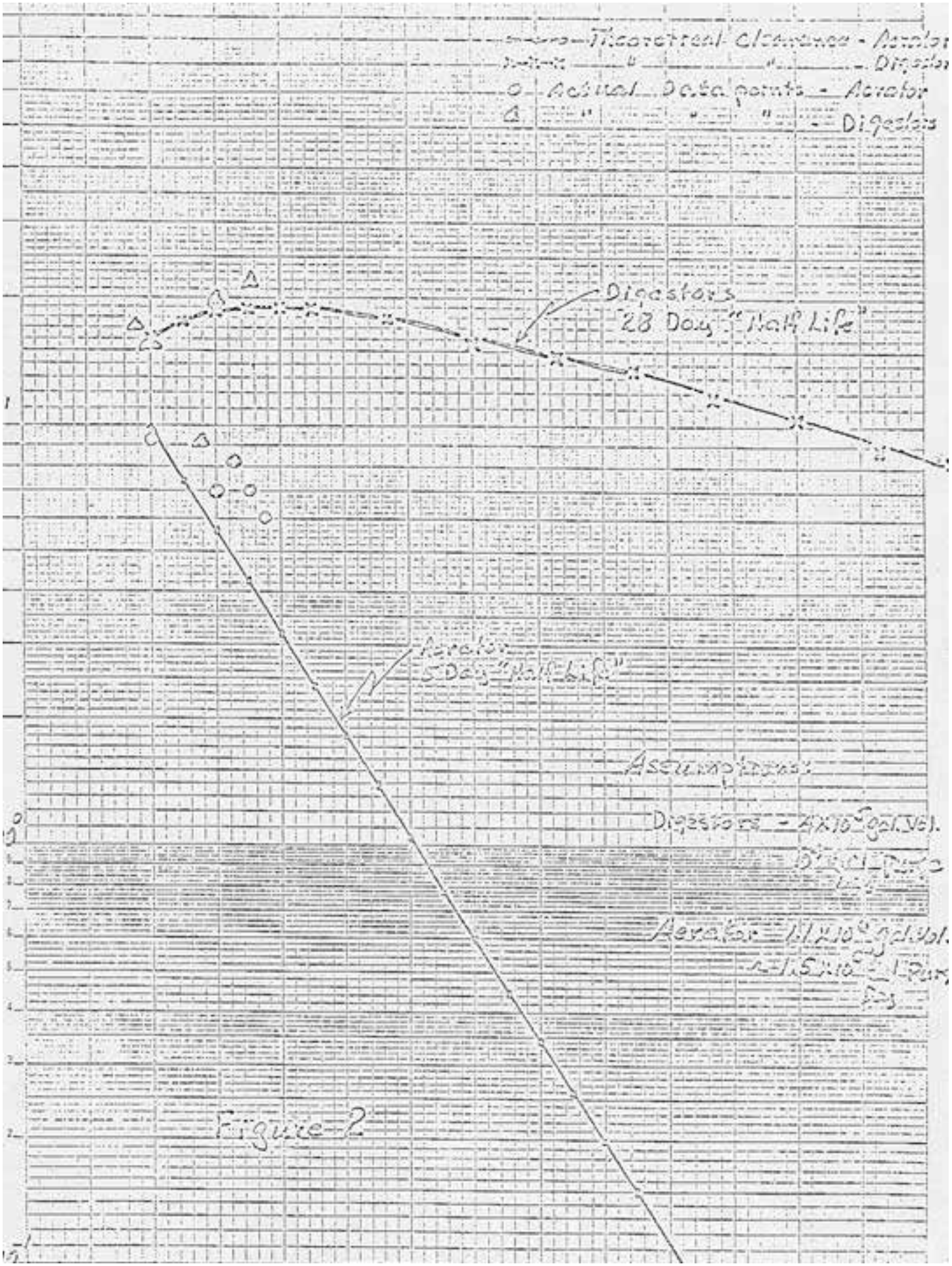
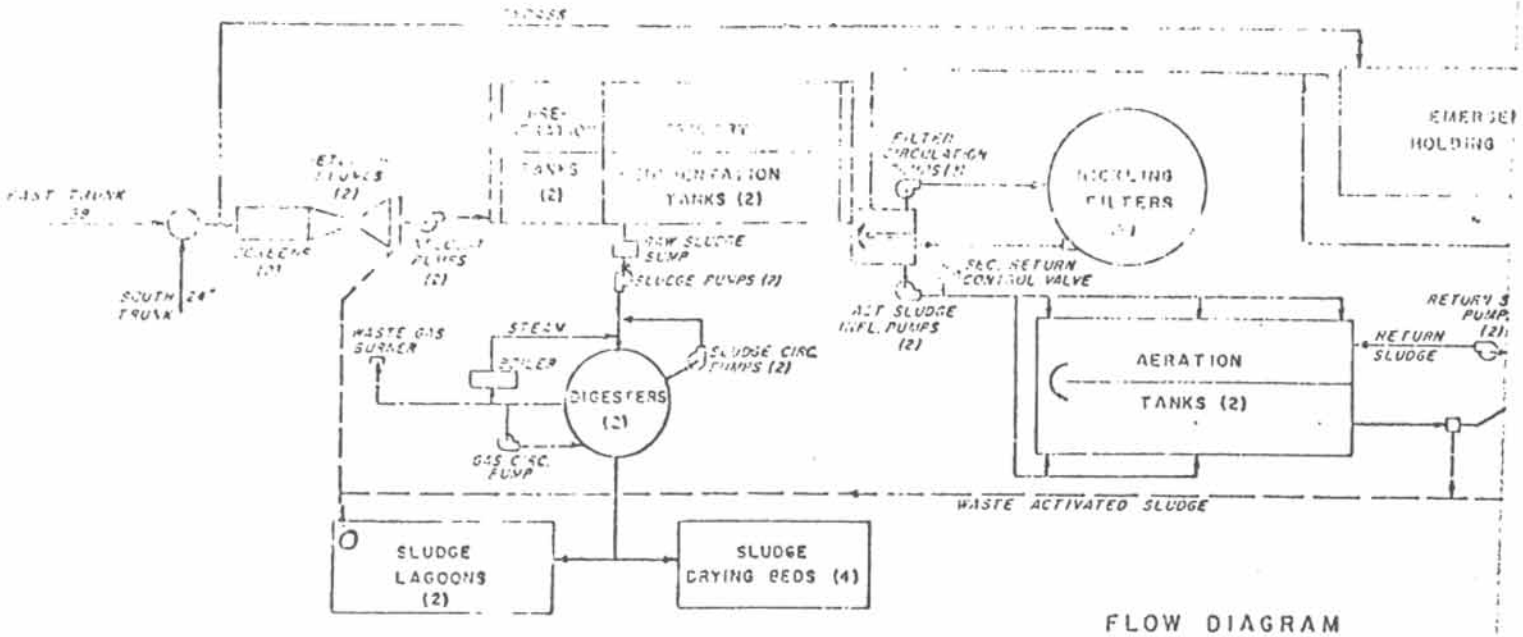

Theoretical Clearance - Aerator
" " " - Digesters
Actual Data points - Aerator
" " " - Digesters
Digesters
28 Days "Half Life"
Aerator
5 Days "Half-life"
Assumptions:
Digesters = 4 x 10^6 gal. Vol.
Aerator = 1.1 x 10^6 gal. Vol.

Figure-2



FLOW DIAGRAM
NO SCALE

DESIGN DATA

FLOW

PRESENT AVERAGE DRY WEATHER, MGD	2.8
2ND STAGE DESIGN, AVERAGE DRY WEATHER, MGD	5.0
2ND STAGE DESIGN, MAXIMUM DRY WEATHER, MGD	10.0
2ND STAGE DESIGN, PEAK STORM RATE, MGD	18.0
FUTURE DESIGN, AVERAGE DRY WEATHER, MGD	10.0
FUTURE DESIGN, MAXIMUM DRY WEATHER, MGD	19.5
FUTURE DESIGN, PEAK STORM RATE, MGD	36.0

DESIGN LOADINGS

2ND STAGE DESIGN, POPULATION EQUIVALENT	62,500
FUTURE DESIGN, POPULATION EQUIVALENT	129,000
SUSPENDED SOLIDS, LBS PER DAY	
PER CAPITA	0.20
2ND STAGE DESIGN	12,500
FUTURE DESIGN	25,800
BIOCHEMICAL OXYGEN DEMAND, LBS PER DAY	
PER CAPITA	0.20
2ND STAGE DESIGN	12,500
FUTURE DESIGN	25,800

INCOMING SEWER

DIAMETER, INCHES	42
CAPACITY, MGD	38

SCREENING EQUIPMENT

COMMINUTOR	
NUMBER	1
CAPACITY, MGD	14.5
BY-PASS SCREEN	
NUMBER	1
CAPACITY, MGD	14

PARSHALL FLUMES

NUMBER	2
THROAT WIDTH, INCHES	[illegible]
CAPACITY, EACH, CFS	[illegible]
FREE CHANNEL, MGD	0.81
FREE CHANNEL, ADAF	1.3

RAW SEWAGE PUMPING UNITS

NUMBER	2
CAPACITY, MGD	12.5
STATIC LIFT, FEET	11

PREAERATION TANKS

NUMBER	2
WIDTH, FEET	19
LENGTH, FEET	38
AVERAGE WATER DEPTH, FEET	11.7
DETENTION TIME, HOURS	0.6
AIR SUPPLIED PER TANK, CFM	150
HYDRAULIC CAPACITY, MGD	10

PRIMARY SEDIMENTATION TANKS

NUMBER	2
WIDTH, FEET	19
LENGTH, FEET	124
AVERAGE WATER DEPTH, FEET	9
EFFLUENT WEIR LENGTH PER TANK, FEET	164
DETENTION TIME, HOURS	1.5
MEAN FORWARD VELOCITY, FPM	1.4
OVERFLOW RATE, GAL PER SQ FT PER DAY AT ADWF	1,050
HYDRAULIC CAPACITY, MGD	10

PRIMARY TREATMENT

ASSUMED SUSPENDED SOLIDS REDUCTION, PER CENT	60
SUSPENDED SOLIDS REDUCTION, LBS PER DAY	7,500
ASSUMED BOD REDUCTION, PER CENT	35
BOD REDUCTION, LBS PER DAY	4,400

TRICKLING FILTERS

NUMBER	2
INSIDE DIAMETER, FEET	110
AVERAGE DEPTH, FILTER MEDIA, FEET	6.25
SIZE OF FILTER MEDIA, INCHES	2 TO 4
AREA OF EACH FILTER SURFACE, ACRES	0.218
VOLUME, ACRE-FEET PER FILTER	0.92
RECIRCULATION RATIO TO ADWF	1.5 TO 3.0
LOADINGS	
GPM PER FILTER, MGD	7.5
GPD PER SURFACE ACRE, MGD	34.8
BOD, LBS PER DAY PER ACRE-FOOT	4,400
ASSUMED BOD REMOVAL, PER CENT	50
BOD REDUCTION, LBS PER DAY	4,000

TRICKLING FILTER [illegible]

NUMBER	
CAPACITY EACH, MGD	
NOS. 1 AND 3	
NO. 2	
AVERAGE STATIC LIFT	

ACTIVATED SLUDGE [illegible]

NUMBER	
AVERAGE WATER DEPTH	
WIDTH, FEET	
LENGTH, FEET	
DETENTION TIME, [illegible]	
AIR SUPPLIED, CU FT	
VOLUME PER TANK,	
VOLUMETRIC LOADING	
RETURN SLUDGE, PER	

AERATION BLOWERS

NUMBER	
CAPACITY EACH, CFM	
DISCHARGE PRESSURE	

ACTIVATED SLUDGE [illegible]

NUMBER	
CAPACITY EACH, MGD	
NO. 1	
NO. 2	
AVERAGE STATIC LIFT	

SECONDARY SEDIMENTATION [illegible]

NUMBER	
DIAMETER, FEET	
SIDE WATER DEPTH	
DETENTION TIME,	
OVERFLOW RATE,	

ACTIVATED SLUDGE [illegible]

ASSUMED SUSPENDED	
SUSPENDED SOLIDS	
ASSUMED BOD REMOVAL	
BOD REDUCTION	

OVERALL PLANT PERFORMANCE

ASSUMED SUSPENDED	
ASSUMED BOD REMOVAL	
EFFLUENT SUSPENDED	
EFFLUENT BOD,	

BROWN AND CALDWELL | CITY OF LIVERMORE, CALIFORNIA | TREATMENT PLANT

TABLE I

Location*	Alpha Activity dpm/l	Volume liters	Total mCi	Comments
eaeration Tanks	1,790	4.8×10^5	0.4	Activity continuously supplied from Secondary Sedimentation tank sludge.
imary Sedimentation nks	166	6×10^5	0.045	Sludge not sampled. Activity here in liquid effluent.
ickling Filters	185	NA	NA	Only liquid effluent sampled.
ration Tanks	5,095	4.1×10^6	9.4	>90% of Secondary Sedimentation sludge returned here.
gesters	23,200	1.5×10^6	15.7	1% solids assumed (0.5 - 2% measured)
econdary Sedimentation ank	36	2.3×10^6	0.045	Liquid phase only sampled.
ludge Lagoons	30 $\frac{dpm}{gm}$**	1.5×10^9 gm or est. 10^3 tons	est.1-4	Very difficult to obtain representative sample.
hlorine Contact ank	None detectable		0	Liquid effluent for uncontrolled use.
		TOTAL	26.6-29.6	

* See Figure 3 - Plant Flow Sheet

* This represents normal "Background" levels. Estimate made by calculation of that released from digesters as of this date.

total 30.4?2