

AD-A156 221

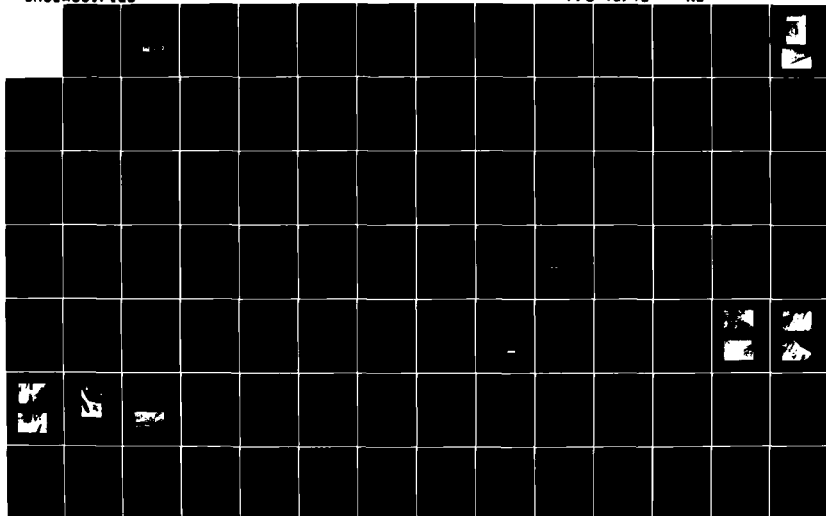
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
MILLVILLE RESERVOIR D..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 78

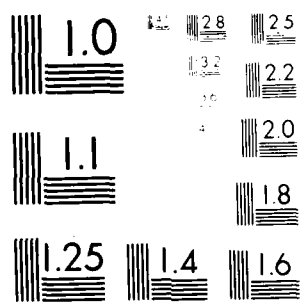
1/1

UNCLASSIFIED

F/G 13/13

NL





U.S. GOVERNMENT PRINTING OFFICE: 1963 O - 348-000



AD-A156 221

MERRIMACK RIVER BASIN
SALEM, NEW HAMPSHIRE

MILLVILLE RESERVOIR DAM

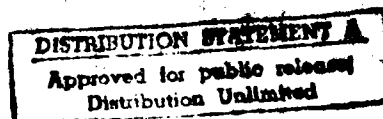
N H 00030
NHWRB 209.08

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DTIC FILE COPY
APRIL 1979



85 06 11 015

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00030	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Millville Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE April 1979
		13. NUMBER OF PAGES 50
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		16a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Merrimack River Basin Salem, New Hampshire Hittytity Brook, Tributary to Spicket River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is an earth and concrete dam with an overall length of 484 ft. and a height of 20 ft. The drainage consists of 10.1 square miles of rolling terrain. It is small in size with a significant hazard potential. It is in poor condition at the present time. Several further investigations and remedial measures need to be implemented at the site.		

DISCLAIMER NOTICE

**THIS DOCUMENT IS BEST QUALITY
PRACTICABLE. THE COPY FURNISHED
TO DTIC CONTAINED A SIGNIFICANT
NUMBER OF PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

JUN 08 1979

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding to you a copy of the Millville Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Spicket River Corporation, 550 Broadway, Lawrence, Massachusetts 01840.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely yours,

Max B. Scheider
MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MINIMUM FISHING DAY

MINIMUM FISHING DAY
NATIONAL DAY INSPECTION PROGRAM

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Avail and/or	
Dist	Special
A/	2

PLANS 1 INSPECTION RENEW
NATIONAL DAY INSPECTION PROGRAM



NATIONAL DAM INSPECTION PROGRAM

FINAL REPORT

Identification No.: NH 0001
NHFD No.: 2000
Name of Dam: MILLVILLE RESERVOIR DAM
Type: Salton
County and State: Rockingham County, New Hampshire
Stream: Hittytity Brook, Tributary to Spicket River
Date of Inspection: November 1, 1978

DAM ASSESSMENT

Millville Reservoir Dam is an earth and concrete dam with an overall length of 481 feet and a height of 21 feet. The concrete spillway is about 125 feet long and concrete abutments are located in each earth embankment section. The outlet structure is a five foot waste pipe which has not been operational for at least two years. An abandoned intake structure is not operable and has been filled with earth.

The dam, which lies on the Hittytity Brook in Salton, New Hampshire, was originally built to supply water for downstream mills. The dam and the dam does not provide water to downstream mills. The dam is located on the west side of the area with rolling hills around the edge of the reservoir. The drainage area consists of 10.1 square miles of rolling terrain. There are numerous reservoirs and swamps upstream of the dam. The dam has a maximum impoundment of 690 acre-feet and height of 18 feet above the dam in the SMALL size category. The possibility of significant property damage but remote chance for loss of life under the assured failure conditions results in a SIGNIFICANT hazard potential classification.

Based on the size and hazard classifications, and in accordance with the Council of Engineers guidelines, the Test Flood Flow would be between the 100-year flood and one-half the 100-year flood (FEMA). Since the hazard potential is on the high side of the SIGNIFICANT category, the Test Flood flow for Millville Reservoir Dam is taken as one-half of the FEMA.

The selected TF inflow to the reservoir is 5050 cfs. Because of the effects of storage the outflow at the dam would be 4.8 cfs with a peak water level 5.6 feet above the minimum spillway elevation or 2.2 feet above the right embankment and 1.4 feet above the left embankment.

The spillway capacity is 1050 cfs prior to overtopping the right embankment. This is 22 percent of the TF flow.

Willville Reservoir is in POOR condition at the present time. Several further investigations and remedial measures need to be implemented at the site. It is recommended that the services of a registered professional engineer be retained to investigate the seepage through the spillway and the downstream training walls, to determine the location and proper method of sealing the outlet from the abandoned overflow structure, to determine the structural adequacy of the waste gate structure, to investigate seepage downstream left of the spillway, and to perform further hydraulic and hydraulic studies to increase the spillway capacity of the dam. The results and recommendations of these future studies should be implemented upon completion of the studies.

Immediate remedial measures should be undertaken by the owner. All deteriorated concrete on the spillway, waste gate structure, and training walls should be repaired as required. Annual dam and inspection should be instituted. The downstream should be cleared from the downstream embankment and debris should be cleared from the downstream channel. A downstream warning system to alert downstream residents in the event of an emergency should be instituted.

The recommendations and interventions outlined above should be implemented within a period of receipt of this report by the owner.



William E. Ziegler

William E. Ziegler
N.H. Registration #220



Nicholas A. Camarillo

Nicholas A. Camarillo, Jr.
California Registration #21006

I have reviewed the report on Millville Reservoir Dam
and the attached drawings. The undersigned Review Board member has
checked the report's findings, conclusions, and recommendations and
has found them to be in accordance with the recommended guidelines for safety inspection
of dams and with sound engineering judgment and practice, and is hereby
submitting for approval.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Garney M. Terzian

GARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Large Dam, Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief Engineer, Washington, D.C. 20541. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving laboratory, modeling, subsurface investigation, testing of detailed structural and evaluation are beyond the scope of a Phase I investigation. However, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of the condition of the dam at inspection along with the available data. In cases where the dam was lowered or drained prior to inspection, such action may improve the stability and safety of the dam, remove the normal load on the structure, and may obscure certain conditions which might otherwise be detectable if inspection were made in normal operating environment of the structure.

It is to be noted that the condition of a dam refers to structure and consists of major internal and external components and is not a mark in nature. It is not possible to assure that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can unsafe conditions be detected.

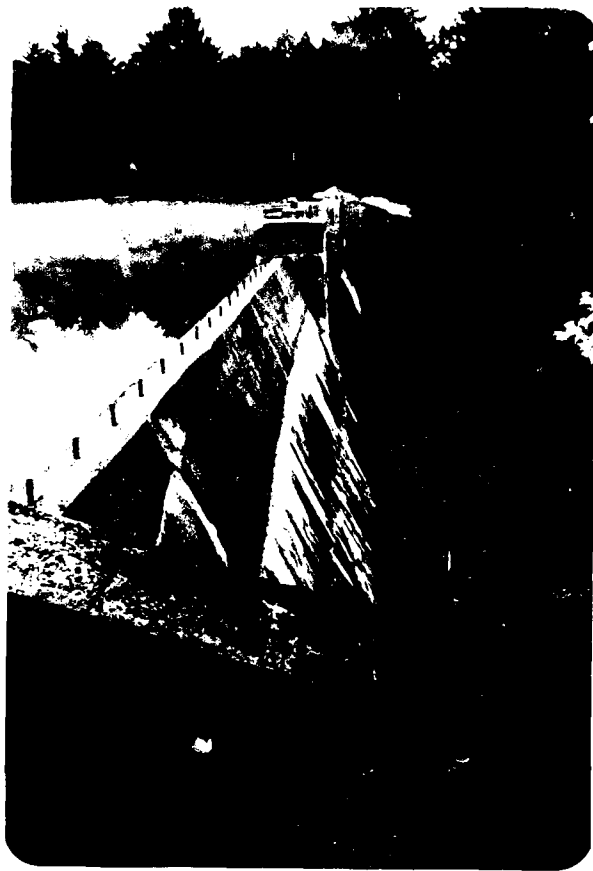
Phase I inspections are not intended to provide detailed hydraulic and hydraulic analyses. In accordance with the established Guidelines, the Test Flood is based on the estimated Probable Maximum Flood for the region, greatest reasonably possible storm run off, or fractions thereof, based on the magnitude and rarity of such a storm event. Assuming that a spillway will not pass the Test Flood should not be interpreted as necessarily posing a highly unusual situation. The Test Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

	<u>Page</u>
INTENT OF TRANSMITTAL	vii
FIELD ADDRESS	viii
REVIEW OF THE SIGNATURE SHEET	ix
FIELD 1	x
FIELD 2 CONTINUED	xi
CONTINUED FIELD 2	xii
FIELD 3 CONTINUED	xiii
SECTION 1 - PRELIMINARY INFORMATION	xiv
1.1 Order	xiv
1.2 Inspections and Reports	xv
1.3 Personnel List	xvi
SECTION 2 - ENGINEERING DATA	xvii
2.1 Design Data	xvii
2.2 Construction Records	xviii
2.3 Operational Records	xix
2.4 Evaluation of Data	xx
SECTION 3 - VISUAL OBSERVATIONS	xxi
3.1 Landing	xxi
3.2 Fueling	xxii
SECTION 4 - OPERATIONAL PROBLEMS	xxiii
4.1 Problems	xxiii
4.2 Maintenance Problems	xxiv
4.3 Maintenance / Operational Problems	xxv
4.4 Identification of Warning System	xxvi
4.5 Evaluation	xxvii

1

7.



Overview from right endwall



Overview from left endwall

On 11/11/68, a letter from the Sheriff's Office, dated 11/11/68, advised that the following information was received from the Sheriff's Office, dated 11/11/68, regarding the above captioned case:

the 1990s, the number of people in the United States who are 65 years of age or older has increased by 50% (U.S. Census Bureau, 1997). The number of people aged 65 and older is projected to increase to 20% of the total population by the year 2020 (U.S. Census Bureau, 1997). The increase in the number of people aged 65 and older has led to a corresponding increase in the number of people who are dependent on others for their care. The number of people aged 65 and older who are dependent on others for their care is projected to increase to 10% of the total population by the year 2020 (U.S. Census Bureau, 1997). The increase in the number of people who are dependent on others for their care has led to a corresponding increase in the number of people who are dependent on others for their care. The number of people aged 65 and older who are dependent on others for their care is projected to increase to 10% of the total population by the year 2020 (U.S. Census Bureau, 1997).

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

cracks are present on the downstream face of the concrete dam. Many of these cracks are still open. Seepage of water is very noticeable on the downstream gallery walls. A considerable amount of material is

1. *Journal of the American Medical Association*, 1997; 277: 1033-1038.

[illegible]

1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Arar and Collins (1971).

The structure extended vertically 100 feet - 125 feet and the left embankment has minor random cracking on its top surface and minor erosion on its upstream face. The erosion is attributed to ice damage. The back face has minor random cracking with no distinct off-ices on it.

Spillway

The right section of the structure (Fig. 1) is eroded, cracked, and effloresced on the downstream face. The left end of this spillway section has two eroded pockets. The first of these pockets is located below the dividing pier about 10 ft. The pocket is 4 feet long, 2 feet high, and up to 12 inches deep. Vegetation is growing in this pocket. There is evidence of past seepage out of this pocket, but none was observed at the time of the inspection. The second pocket is located about 10 ft. to the right of the dividing pier and is about 10 feet from the downstream pier. This pocket is 4 feet long, 2 feet high, and up to 12 inches deep. It is about 1 foot long, 2 feet high, and up to 12 inches deep. It continues into this pocket. Seepage is flowing out of the pocket at a rate of about 1 gpm. The crest is eroded and the structure has been subjected to alternating stresses and strains. A continuous horizontal crack is visible along the downstream face of the spillway. This point is effloresced. There are several vertical hairline cracks which are also effloresced. The pier dividing the right section of the spillway is eroded at its base. The right section of the spillway is eroded at its base. The downstream face of the spillway is eroded at its base. The downstream face of the spillway is eroded at its base.

The center section of this structure (Fig. 1) has two open horizontal construction joints and one open vertical construction joint. Seepage at the rate of 1 to 1 gpm is flowing out of the vertical joint. The intermediate pier is eroded at its interface with the spillway crest, and its downstream vertical face is eroded. This erosion is attributed to the dam.

The downstream face of the left spillway section (Fig. 4 & 7) is in very poor condition. It is about 4 ft. from the downstream face of the spillway. The concrete curb wall was placed over the right spillway section, is undermined over about 8 ft. of its length at the interface with the old spillway. Seepage of about 1 to 2 gpm was observed at this interface. Random vertical cracks are at

SECTION 5 - VISUAL OBSERVATION

| | 1 | 2 | 3 | 4 | 5 |
|---|-------|-------|-------|-------|-------|
| 1 | 1 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 0.000 | 1 | 0.000 | 0.000 | 0.000 |
| 3 | 0.000 | 0.000 | 1 | 0.000 | 0.000 |
| 4 | 0.000 | 0.000 | 0.000 | 1 | 0.000 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 1 |

Figure 1. (a) $\log_{10}$ of the number of *S. aureus* per gram of meat and (b) $\log_{10}$ of the number of *E. coli* per gram of meat.

[illegible][illegible]

1. *Journal of the American Statistical Association*, 1990, 85, 1001-1013.

The Commission of the European Communities has been established by the Council of Ministers of the European Community, which is the main decision-making body of the Community. The Commission is responsible for ensuring that the Community's policies are implemented and for proposing new legislation. It also has the power to bring legal actions against member states that fail to comply with Community law.

1. The following information was obtained from the FBI file on the above named subject:

1. *Formal System and Syntax* (1974) 200 pp.

[illegible]

A horizontal construction about 1 foot approximately 5 feet above the stream bed has been placed across the river over its entire length about 20 feet downstream from the dam. This structure, the training wall has a slope of 1 foot vertical to 1 foot horizontal. The structure is placed at the base of the wall and seeps at the rate of about 1 inch per observed flood. The wall the structure is 100 feet long.

SECTION 2 - ENGINEERING DATA

2.1. General

A few design drawings and calculations are available in the files of the Air Engineer. Further drawings and calculations are not available and are not in the entire set. The amount varies considerably over its length.

2.2. Construction Data

The construction data were not available for

the entire set.

The construction data were not available for

2.3. Design Data

The design data

The design data are comprehensive design drawings and calculations with significant shortcomings. An overall assessment for availability, and therefore, for

the design data

The design data are comprehensive design drawings and calculations with significant shortcomings. An overall assessment for availability, and therefore, for the design data. This assessment is to be made primarily on the visual inspection, past performance, and sound engineering judgment.

Validated

Since the observations of the inspection team refer to the limited information contained in the report, the NRP's satisfactory evaluation for availability is

4) Gates: One timber waste gate over 5 foot diameter steel outlet conduit.

5) V/S channel: 10' ad apron at fringed

6) B/S channel: 75 feet wide

7) Channel: 10'

Regulating Outlet

The only operable regulating outlet is the timber waste gate in the spillway. It regulates flow into 5 foot diameter steel outlet conduit with invert elevation 111. The waste gate is operated manually by hand wheel and rack system.

(11) Flowage or Spring (approx.)

- (1) Natural () Art ()
- (2) Flowage () Spring ()
- (3) Flowage () Spring ()
- (4) Flowage () Spring ()
- (5) Flowage () Spring ()

(12)

- (1) Type Concrete gravity and concrete
- (2) Length 450 feet
- (3) Height 12 feet
- (4) Width 8 feet earth embankment
- (5) Side Slope 1:1 horizontal to 1 vertical embankments
- (6) Foundation Unknown
- (7) Impervious Core Concrete core
- (8) Material Concrete embankment
- (9) Grout Curtains None
- (10) Other None

(13) Diversed and Regulating Tunnel ()

(14) Spillway

- (1) Type Concrete gravity
- (2) Length of weir Right Section 47.2 feet
Center Section 30 feet
Left Section 24.2 feet
- (3) Crest Elevation Right Section 137.5
Center Section 136.5
Left Section 135.5

(6) Gated spillway capacity at test flood elevation - Not applicable

(7) Total spillway capacity at test flood elevation - Same as (4) above

(8) Total project discharge at test flood elevation - Not interrupted by test dam

2.0.2.2.2. Data above Msig

(1) Streambed at centerline of dam: 111 ±

(2) Height of structure: 100 ±

(3) Stream bed invert downstream: 111 ±

(4) Normal pool: 110 ±

(5) Flood control pool: 111 ±

Spillway crest to right section: 117.5
center section: 116 ±
left section: 115 ±

(6) Design structure vertical design: Unknown

(7) Design: 110 ±

(8) Crest of structure: 111 ±

3.0.2.2.2. Data

(1) Length of maximum pool: 4700 feet ±

(2) Length of normal pool: 4300 feet ±

(3) Length of flood control pool: NS

4.0.2.2.2. Storage (in 100-feet)

(1) Normal pool: 500 ±

(2) Flood control pool: 100 ±

(3) Spillway crest pool (lowest section): 500 ±

(4) Top of dam: 690 ±

(5) Test flood: 830 ±

2.0 Purpose of Dam

The reservoir impounded by the dam provides a recreational and aesthetic function for the residents of the area.

3.0 Design and Construction History

According to specifications for the dam dated August 11, 1917, the dam was constructed for Arlington Mills of Lawrence, Massachusetts. No major changes were made to the structure, however, the sluice gate was rehabilitated approximately 5 years ago according to the records of the Salem River Company.

4.0 Operational Procedures

The dam is no longer operated. Mrs. L. M. Smith, the site owner, and clears brush off the embankment and spillway. This is the only maintenance in operation at the dam.

5.0 Drainage Area

Drainage Area

The drainage area of the dam is 1.1 square miles of rolling terrain. There are numerous small reservoirs and ponds upstream of the dam.

6.0 Discharge of Dam

1. Outlet Works

At present there are no operable outlet works at the dam. There is a 5 foot diameter culvert passing through the spillway with an invert elevation of about 12.0.

2. Maximum Flood at Dam Site - Unknown

3. Spillway Capacity at Maximum Possible Flood Flood is 106 cfs

Spillway capacity at test flood elevation - 12.0
overtopped by test flood

4. Gated Spillway Capacity at Normal Pool Elevation Elevation - Not applicable

(3) Left Core Walls and Embankment

The left side of the dam consists of an earth embankment with an eight foot crest width and a concrete core wall. The right portion of this section is approximately 98 feet long and extends along the projection of the spillway dam. The left portion slopes upstream at approximately 45 degrees for a distance of about 130 feet.

(4) Abandoned Intake Structure

A cellular concrete structure approximately 6 feet square is shown on Figure 4-2 and 4-3 and is located 3 feet upstream from the left end of the spillway. It has been filled with earth and abandoned.

5. Dam Classification

The dam is maximum impoundment of the upstream hydraulic height of 15 feet place this dam in the "Small" size category as defined in the "Recommendations" guidelines.

6. Hazard Potential Classification

The appropriate hazard potential classification for Millville Reservoir is SIGNIFICANT. A failure of the dam would result in a 1.2 foot rise in the water level in the residential development downstream. With 1 to 2 houses would be flooded, the small rise in water level in the event of a dam failure does not present a significant threat to lives.

7. Ownership

The dam is owned by the Spicket River Corporation which is located in Lawrence, Massachusetts. The address is 550 Broadway, Lawrence, Massachusetts, 01840. Mr. Russell is responsible for the dam for the owners and can be reached by telephone at 017-680-3840.

8. Operation

Mr. Harlan Low operates the dam for the owner under the supervision of Messrs. Marlenson and Besvill. Mr. Low's address is Windham Depot Road, LEF 1, Derry, New Hampshire, 03038. His telephone number is 603-432-3423.

(4) Spillway

This concrete gravity structure is divided into three sections. The right section of the spillway is 23 inches lower than the adjacent embankment on the right. This yields a crest elevation of 137.5. This section of spillway is 41.0 feet long, and flashboard stanchions are in place at 30 inches on center. The center spillway section has an overall length of 34 feet with an intermediate pier of 4 feet. The crest elevation of this section is 137.0. The left spillway section is approximately 20.2 feet long and has a crest elevation of 138.0. A 2 foot by 2 foot pier divides this portion of the spillway in half. The pier dividing the right and center sections is 4 feet long (parallel to the spillway axis) and 5 feet wide. The pier dividing the center and left sections is 11.2 feet long and 5 feet wide.

The waste gate structure located in the spillway is below the pier separating the center and left spillway sections. The structure has a vertical sluice gate and a 5 foot diameter steel ball check valve. The training walls extend upstream into the impoundment pool on either side of the structure. The top width of these walls is 12 feet. These walls are level for about 10 feet and then slope into the reservoir. The bottom level could not be determined. The tops of the walls are approximately 4.6 feet below the last crest level or at elevation 134.4.

(5) Left Spillway End Structure

This concrete gravity structure consists of three sections. The first section is a wall approximately 13 feet long and continues along the spillway axis line. The second section is approximately 13 feet long and is located downstream of the spillway. This section is skewed slightly to the left of the normal to the spillway axis. The third section is approximately 15 feet long and serves as a downstream training wall. This wall skews into the left bank at about a 30 degree angle.

1.2 Description of Project

(a) Location

Millville Reservoir Dam lies on Hittytity Brook, which is a tributary of the Spicket River in the State of New Hampshire. The dam lies about 2 miles upstream from the confluence of Hittytity Brook and the Spicket River. The dam can be reached via an access road located about 700 feet south of the intersection of Millville Street and Bluff Street in Salem, N.H. The portion of the 18 x 36 map in N.H. - Mt. quadrangle presented previously shows this location. Figure 1 of Appendix B presents a detail of the site developed from the inspection view of the dam.

(b) Description of Dam and Appurtenances

1. General

The dam consists of a three section concrete gravity spillway with a waste gate, a right spillway end structure, a left spillway end structure, and concrete core walls extending into the embankments at the left and right ends of the spillway. The overall length of the dam is about 580 feet, of which the three spillway sections total 120 feet. The embankment on the right side extends about 60 feet before joining the natural ground.

2. Right Embankment

The right embankment has an 8 foot crest width extending about 60 feet from the end of the spillway before joining natural ground. The earth embankment has a concrete core wall which is 60 feet long.

3. Right Spillway End Structure

This structure is a concrete gravity training wall which is at a right angle to the spillway wall. The concrete core wall connects to the training wall at its upstream end. The training wall is 44 feet long, and the top of the wall slopes downstream at 4 horizontal to 1 vertical. The top width of the wall is 2 feet.

PHASE I INSPECTION REPORT

WILMINGTON RESERVOIR DAM

SECTION 1

1.1. NOT INFORMATION

1.1.1. Purpose

1.1.1.1. Authority

Public Law 92-587, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Goldberg, Zeiter, Dunnelliff & Associates, Inc. (GZD) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed was issued to GZD under a letter of November 28, 1975 from Colonel Max B. Schneider, Corps of Engineers. Contract No. DAWC 33-74-1-2010 has been assigned to the Corps of Engineers for this work.

1.1.1.2. Purpose

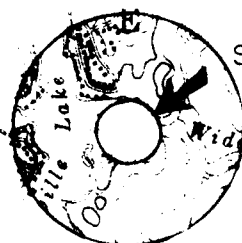
(1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

(3) Update, verify, and complete the National Inventory of Dams.

1.1.1.3. Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dam.



SITE

— SCALE —

0 1000 2000 4000 FT

FROM: USGS SALEM DEPOT, N.H.
MASS QUADRANGLE MAP

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC, INC
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

U.S. ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN

MILLVILLE RESERVOIR DAM

NEW HAMPSHIRE

SCALE AS NOTED

DATE NOVEMBER 1978

FILE No 2201

5.2 Evaluation

The dam is in poor condition at the present time. The spillway, training walls, and other concrete structures are severely deteriorated and require considerable reinforcement. The general condition of the dam is a result of poor maintenance. An improved maintenance program is required if the dam is to be maintained in operation.

SECTION 4 - OPERATIONAL PRESENTS

4.1.1. Introduction

At present the dam is not operational. Although the dam is not operational, it is in a state of disrepair and is in need of major repairs.

4.1.2. Dam Structure

Mr. Harold Lee visits the site weekly but the dam is not operational. The dam is in a state of disrepair and is in need of major repairs.

4.1.3. Dam Structure

The dam is owned by Mr. Harold Lee. The dam was rehabilitated 5 years ago. The dam is in a state of disrepair and is in need of major repairs. The dam is in a state of disrepair and is in need of major repairs.

4.1.4. Dam Structure

There is a small warning system in place for this dam.

4.1.5. Dam Structure

The dam is owned by Mr. Harold Lee. The dam is in a state of disrepair and is in need of major repairs. The dam is in a state of disrepair and is in need of major repairs. The dam is in a state of disrepair and is in need of major repairs.

SECTION 5 - HYDRAULICS/HYDROLOGY

5.1 Evaluation of Dam

(a) General

Millville Reservoir Dam is an earth and concrete structure on the Hittytity Brook in Salem, N.H. The reservoir area is approximately 54 acres. The spillway is a 3 level structure with a total length of about 120 feet. Earth embankments with concrete core walls extend from each end of the spillway. The drainage area is 1.1 square miles of rolling terrain. There are numerous streams, ponds and swamps upstream of the dam.

(b) Data Sources

Data sources available for Millville Reservoir Dam include former inventory and inspection reports. Much of the basic data on the dam is contained in the New Hampshire Water Control Commission's "Data on Dams in New Hampshire" (July 14, 1960), the New Hampshire Water Resources Board's "Inventory of Dams and Water Power Developments" (October 3, 1957), and the Public Service Commission of New Hampshire's "Dam Report" (November 6, 1935). Inspection reports dated Jan. 25, 1940; July 25, 1941; December 1, 1941; August 16, 1961; August 20, 1971; November 17, 1971 are available as are numerous letters regarding the condition of the dam.

The construction specifications and some sketches from 1917 are available. Calculations from a 1963 study of the dam's stability are also available.

(c) Experience Data

No records of flood or stage are known to be available for Millville Reservoir Dam.

(d) Visual Observations

The reservoir has an area of about 54 acres. The pond is surrounded by houses, most of which were formerly used only during the summer but which are now used year-round. Many of the houses near the dam have ground floor elevations nearly equal to the top of the dam. Overtopping of the dam would also be accompanied by partial flooding of these houses.

The channel downstream of the dam becomes part of the Widow Harris brook which joins the Spicket River about 1-1.4 miles downstream of the dam. Immediately downstream of the dam the channel is about 75 feet wide and flat for about 50 feet before entering a small lake. A residential area of Salem is located in this area with many residences in the flood plain of the Widow Harris brook.

The water elevation downstream of the dam is controlled by a culvert under one of the roads in the residential area. The culvert is circular with a 12 foot diameter. At present about half of the culvert is covered by sediment. The roadway is about 5 feet above the top of the culvert.

From this point the Widow Harris brook flows through a succession of swampy areas and culverts. A total of 1.4 miles of culverts and swampy areas were encountered in the 1-1.4 mile stretch between the dam and the Spicket River. The area around the swamps is extensively developed with many residences along the edges.

Test Flood Analysis

The hydraulic conditions of interest in the flood investigation are those required to assess the dam's overtopping potential and its ability to safely allow appropriate flood to pass. This requires knowledge of the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. None of the original hydraulic and hydrologic design records are available for use in this study.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of 690 acre-feet and height of 14 feet classify this dam as a SMALL structure.

The appropriate hazard classification for this dam is SLIGHT HAZARD. If Millville Reservoir had were to fail, there would be a noticeable increase in the dam in the residential development downstream of the dam. Although property damage caused by a failure would be high, the small rise in water level does not present a large threat of loss of life.

As shown in Table 3 of the Corps of Engineers' "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL with a SIGNIFICANT hazard classification is between the 100 year flow and one-half of the Probable Maximum Flood (PMF). Since the hazard classification is on the high side of the SIGNIFICANT category, one-half of the PMF is appropriate to use as the Test Flood for this Dam.

The rolling terrain upstream of the dam, interspersed with swamps and ponds, indicates a one-half PMF flow of about 500 cubic feet per second per square mile. For the 1.7 square mile drainage area, this yields a peak flow to the reservoir of 500 cfs. This flow will be attenuated by storage in Millville Reservoir and the peak outflow would be about 400 cfs with a peak water level 0.6 feet above the minimum spillway elevation of 130.0. This water level is 2.2 feet above the right abutment and 1.4 feet above the left abutment. The spillway capacity is only 1050 cfs which is 2.6 times of the test flood.

4.2.1.1. Failure Analysis

The peak outflow that would result from a tailwater pondage is estimated using the procedure suggested by the Corps of Engineers New England Division April 1975, "Guidelines for Estimating Maximum Probable Flood Discharge," as explained in the report of 7-1075-100-1. Failure is assured to occur with the water surface elevation at the top of the right abutment wall 1.4 feet above the minimum spillway crest elevation of 130.0.

The discharge prior to failure with the water level at the dam crest would be 1050 cfs as determined from the stage-discharge curve as described in Appendix 1. The tailwater prior to failure would be 130.5 feet MSL, 0.5 feet below the spillway crest. This would be 0.5 feet above the right abutment and would cause some flooding in the residential area about 1.4 mile downstream of the dam.

With a ninety-six foot gap opened in the dam, failure would cause the flow to increase by 429 cfs to a total of 1340 cfs. This would cause the tailwater to rise 1.2 feet to 131.7 feet (MSL). This increase to the level of flooding in the residential area downstream of the dam would be significant as there are about 10 to 25 houses around elevation 130 feet (MSL).

The nature of the downstream area places the safety of this dam in a more critical light. The floodplain area is the backyard of numerous new homes, housing mostly families with young children. If the dam were to fail under normal conditions, not during a major flood event, there is a chance that children would be playing in the downstream area. This combination of circumstances does not merit the HIGH hazard classification, but it does require a thorough hydrologic examination for this dam.

The topographic data and flow routing procedure used in this study were appropriate to a Phase I study. The present examination is based on a less accurate, but still similar data source. It is recommended that a more detailed hydrologic investigation be conducted to determine the downstream flood hazard potential.

SECTION C - STRUCTURAL STABILITY

C.1 Evaluation of Structural Stability

(a) Visual Observations

1. Spillway

The field investigation revealed seepage flowing through the right and left spillway sections and the left and right training walls. The seepage conditions warrant further investigation and recommendations for structural stability.

2. Right Section

The right section of the spillway is eroded, cracked and filled. Two eroded pockets were observed in the spillway section and seepage was flowing through one of the pockets at the time of the investigation. The pier separating the right and center spillway sections is also eroded.

The center spillway section has several seepage restriction points with seepage flowing at various points. The intermediate pier is eroded at the spillway interface and on its upstream side.

The left spillway section is spalled, cracked and discolored. Its surface area is deteriorated and is undermined where it joins the original spillway crest, and seepage was observed at this interface. Many effloresced random cracks were observed on this spillway section.

3. Gate Structure

The concrete on the waste gate structure is severely spalled and rusted reinforcement is exposed. The reinforcement is rusted through at the narrow top water elevation and seepage was observed from the bottom of the gate.

4. Downstream Training Walls

The right downstream training wall is spalled and eroded in several places. Seepage was observed at two separate places through the wall, and many other cracks are effloresced.

The left downstream training wall is severely spoiled. Seepage was observed through a portion of the wall, and large diagonal cracks have developed at the interface between the old downstream wall and the new wall.

• *Staphylococcus aureus* (100%)

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED
DATE 08-11-2010 BY 60322 UCBAW/BJS

1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Arar and Collins (1971) using a Shimadzu 1601 UV-Visible Spectrophotometer.

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The concentration of the *Agrobacterium* suspension was 10⁶ cells/ml (○), 10⁷ cells/ml (□), 10⁸ cells/ml (△), and 10⁹ cells/ml (◇). The error bars represent the standard deviation of three independent experiments.

1. Cost Construction Change

[illegible][illegible]

The dam is located in Seismic Zone 1. It is a gravity dam with a maximum height of 100 feet. The dam is constructed of concrete and has a crest width of 10 feet. The dam is located on a foundation of bedrock. The dam is subject to seismic loading. The dam is in good condition and is expected to have a service life of 100 years.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS,
AND REMEDIAL MEASURES

7.1 PRE-ASSESSMENT

The Millville Reservoir dam is in POOR condition at the present time. The seepage through the concrete spillway and both training walls should be brought under control to prevent further concrete deterioration. The following table of potential structures should be noted for future evaluation.

TABLE 1 - POTENTIAL STRUCTURES

Table 1 is a list of in-depth engineering data developed for a definitive review. Therefore, the assessment of the structures should be assessed from the standpoint of the data available. This assessment is based on the visual inspection and the data available for the engineering judgment.

TABLE 1

The following table is a list of structures which are listed in the Appendix A of the report with the following information: (1) Name of structure; (2) Location; (3) Condition; (4) Remarks.

TABLE 1 - Continued - Investigation

Additional investigations should be performed for the structures outlined in Paragraph 7.2.1.1.

7.2 RECOMMENDATIONS

It is recommended that the services of a registered professional engineer be retained to:

Investigate the dam and undrained area adjacent to the spillway and seepage through the spillway and training walls to determine the cause and proper method of sealing the outlet from the spillway intake structure, and to determine the structural adequacy of the waste gate structure.

4. Perform further hydrologic and hydraulic studies to determine the need for additional storage capacity.
5. Increase the crest of storage 75 feet downstream and 25 feet left of the left downstream channel.
6. Develop plans for repair of all deteriorated portions of the spillway and training walls.

The Corps should implement the findings of the engineering study.

4.2.2.2. Recommendations

The Corps should consider the following recommendations for implementation of the study.

1. Remove all trees from downstream of the spillway and in all other areas where they are a hazard.

2. Remove all debris from downstream channel.

3. Implement program of annual technical inspection of the spillway.

4. Implement program of annual inspection of the spillway.

4.2.2.3. Alternatives

The Corps should consider the following alternatives to the above recommendations. The Corps should consider the following alternatives to the above recommendations. However, since the spillway is located around the reservoir, the Corps should consider the following alternatives.

ANNEX
VISUAL INSPECTION CHECKLIST

MINNESOTA DEPT. OF COM.
SALT LAKE CITY

NO. 107-
November 11, 1974

CHECK LISTS FOR VISUAL INSPECTION

| AREA AVAILABLE | PC | CONDITION & REMARKS |
|--|-----|--|
| 1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
32.
33.
34.
35.
36.
37.
38.
39.
40.
41.
42.
43.
44.
45.
46.
47.
48.
49.
50.
51.
52.
53.
54.
55.
56.
57.
58.
59.
60.
61.
62.
63.
64.
65.
66.
67.
68.
69.
70.
71.
72.
73.
74.
75.
76.
77.
78.
79.
80.
81.
82.
83.
84.
85.
86.
87.
88.
89.
90.
91.
92.
93.
94.
95.
96.
97.
98.
99.
100. | 100 | 1. All items are in good condition.
2. No items are missing.
3. No items are damaged.
4. No items are expired.
5. No items are out of date.
6. No items are out of place.
7. No items are out of order.
8. No items are out of stock.
9. No items are out of sight.
10. No items are out of reach.
11. No items are out of use.
12. No items are out of place.
13. No items are out of order.
14. No items are out of stock.
15. No items are out of sight.
16. No items are out of reach.
17. No items are out of use.
18. No items are out of place.
19. No items are out of order.
20. No items are out of stock.
21. No items are out of sight.
22. No items are out of reach.
23. No items are out of use.
24. No items are out of place.
25. No items are out of order.
26. No items are out of stock.
27. No items are out of sight.
28. No items are out of reach.
29. No items are out of use.
30. No items are out of place.
31. No items are out of order.
32. No items are out of stock.
33. No items are out of sight.
34. No items are out of reach.
35. No items are out of use.
36. No items are out of place.
37. No items are out of order.
38. No items are out of stock.
39. No items are out of sight.
40. No items are out of reach.
41. No items are out of use.
42. No items are out of place.
43. No items are out of order.
44. No items are out of stock.
45. No items are out of sight.
46. No items are out of reach.
47. No items are out of use.
48. No items are out of place.
49. No items are out of order.
50. No items are out of stock.
51. No items are out of sight.
52. No items are out of reach.
53. No items are out of use.
54. No items are out of place.
55. No items are out of order.
56. No items are out of stock.
57. No items are out of sight.
58. No items are out of reach.
59. No items are out of use.
60. No items are out of place.
61. No items are out of order.
62. No items are out of stock.
63. No items are out of sight.
64. No items are out of reach.
65. No items are out of use.
66. No items are out of place.
67. No items are out of order.
68. No items are out of stock.
69. No items are out of sight.
70. No items are out of reach.
71. No items are out of use.
72. No items are out of place.
73. No items are out of order.
74. No items are out of stock.
75. No items are out of sight.
76. No items are out of reach.
77. No items are out of use.
78. No items are out of place.
79. No items are out of order.
80. No items are out of stock.
81. No items are out of sight.
82. No items are out of reach.
83. No items are out of use.
84. No items are out of place.
85. No items are out of order.
86. No items are out of stock.
87. No items are out of sight.
88. No items are out of reach.
89. No items are out of use.
90. No items are out of place.
91. No items are out of order.
92. No items are out of stock.
93. No items are out of sight.
94. No items are out of reach.
95. No items are out of use.
96. No items are out of place.
97. No items are out of order.
98. No items are out of stock.
99. No items are out of sight.
100. No items are out of reach. |

10-1111-1111-1111

10-1111-1111-1111
10-1111-1111-1111

CHEE LISTS FOR VISUAL INSPECTION

| AREA INSPECTED | BY | CONDITION & REMARKS |
|-----------------------|-----|---|
| 1. Engine compartment | APC | No oil leaks, no unusual noises. |
| 2. Fuel system | NAC | Fuel lines secure, no leaks. |
| 3. Electrical system | AC | Battery terminals clean, no corrosion. |
| 4. Landing gear | 1 | Gear operation normal, no unusual noises. |
| 5. Brakes | 1 | Brake pads worn, need replacement. |
| 6. Tires | 1 | Tire pressure normal, no visible damage. |
| 7. Propeller | 1 | Propeller blades clean, no damage. |
| 8. Landing gear | 1 | Gear operation normal, no unusual noises. |
| 9. Brakes | 1 | Brake pads worn, need replacement. |
| 10. Tires | 1 | Tire pressure normal, no visible damage. |
| 11. Propeller | 1 | Propeller blades clean, no damage. |
| 12. Landing gear | 1 | Gear operation normal, no unusual noises. |
| 13. Brakes | 1 | Brake pads worn, need replacement. |
| 14. Tires | 1 | Tire pressure normal, no visible damage. |

25'-2"

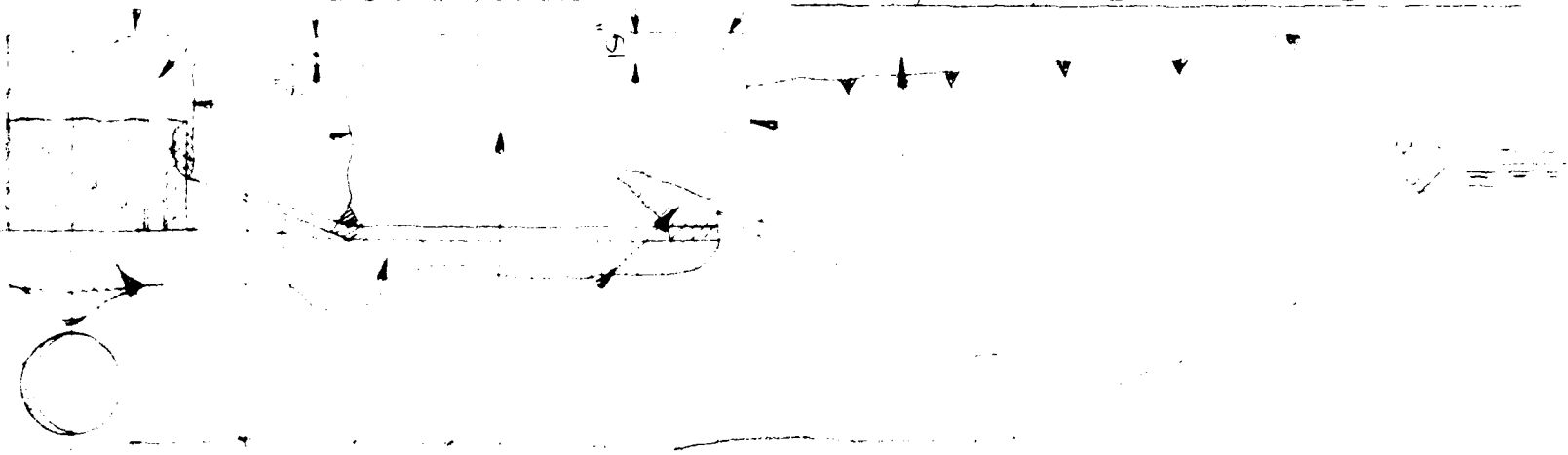
2'-0" 0'-4"

1. OF THE GATE STRUCTURE & 50 STEPS DOWN TO

CONCRETE SPALLING OVER THE ENTIRE TOP SURFACE

HIGH DEGREE OF RANDOM CRACKING & DISINTEGRATION

W/ EFFLORESCENCE UP TO 1/4" DEEP IN THE
STEEL CHANNEL TYPE. WOOD HAS BEEN CRACKING AT THE



PRESIDENT SPIRITUAL

CONCRETE SPALLING AND HIGH
DEGREE OF CONCRETION

CRACKING & EFFLORESCENCE

DOWNSTREAM CHANNEL

33-0"

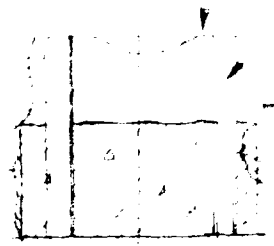
34-0"

35-0"

LOF

ERODED POCKET

IN FROZEN



OPEN VERTICAL
JOINT

ERODED POCKETS UP TO 3'
DEPTH W/ SEEPAGE

OPEN HORIZONTAL
JOINTS

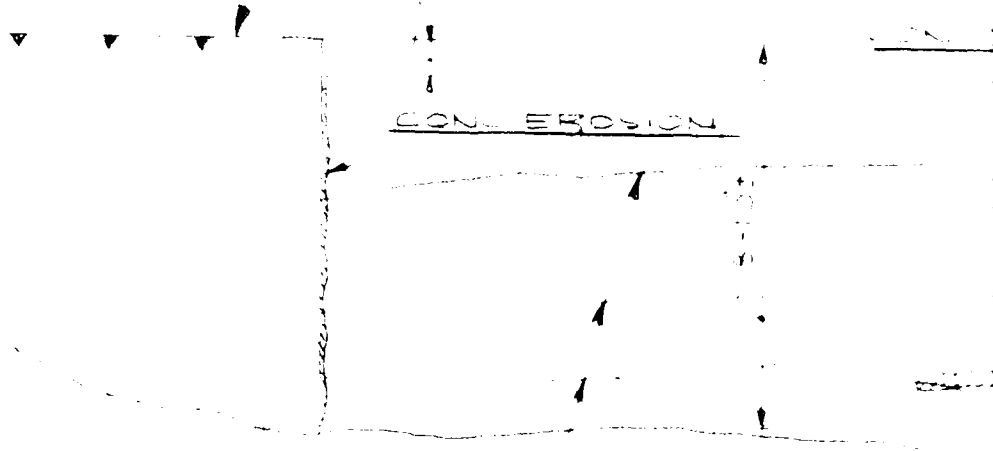
APPENDIX 2

DOWNSTREAM ELEVATION

SCALE: 1/8" = 1'-0"

11
41-57

ANALYSIS OF
SEEPAGE AND
WATER SPALLING AT THE
TOP SURFACE



CONCRETE EROSION
SEEPAGE

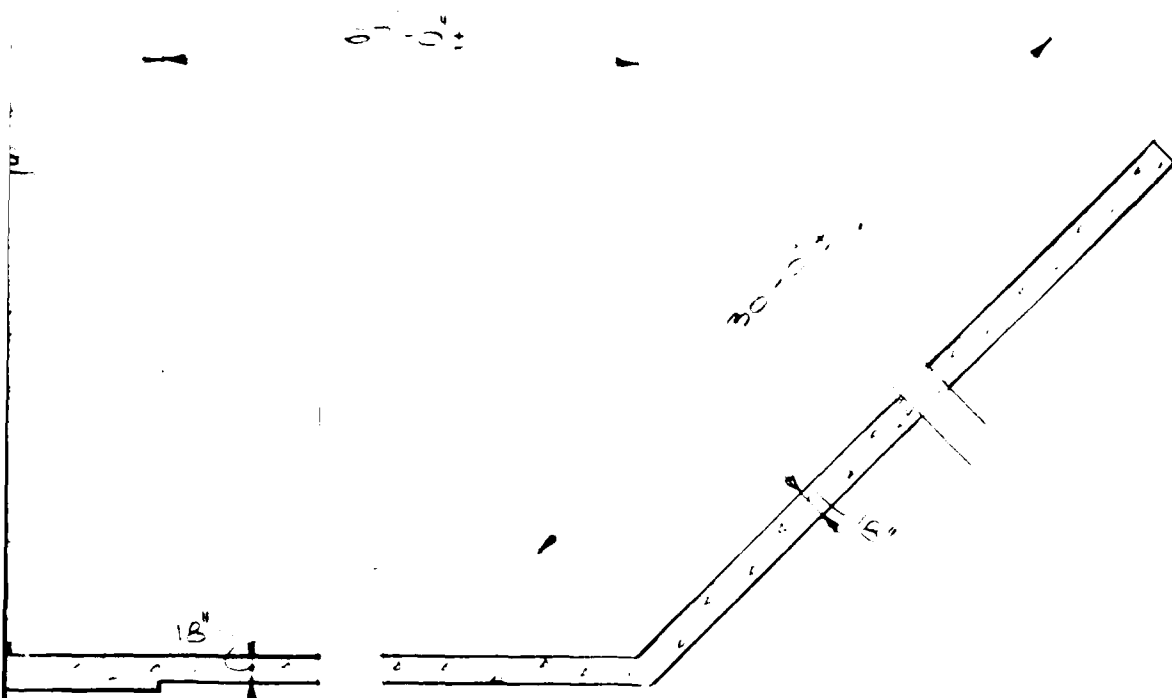
OPEN CONSTRUCTION
DEGREE OF EROSION

SCA

NOTES

1. DAM INSPECTED ON NOVEMBER 1, 1978 BY GOLDBERG, ZOINO, DUNNICLIFF
AND ASSOC., INC.

| | | | |
|--|--|--|--|
| GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS | | U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS | |
| NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS | | | |
| FIGURE 2 | | | |
| PLAN OF DAM | | | |
| MILLVILLE RESERVOIR DAM | | NEW HAMPSHIRE | |
| | | SCALE 1" = 5' | |
| | | DATE NOVEMBER 1978 | |



NOTES

1. DAM INSPECTED ON NOVEMBER 1, 197
AND ASSOC., INC.



OF SLOPE (TYPE)

| |
|---|
| GOLDBERG, JOINT
GEOTECHNICAL
NEWTON UPPER |
| NATIONAL |
| MILLVILLE |
| |
| |

20

10'-0"
10'-0"
10'-0"

3'-0"

44'-0"

1

HIGH DEGREE OF CONC. SPALLING
CONC. CAP UNDERMINED

MINOR EROSION

ABANDONED INTAKE STRUCTURE
(FILLED WITH EARTH)

APPROX. TOE OF
SLOPE (TYP.)

MINOR HAIRLINE CRACKING
AT THE TOP SURFACE

MINOR RANDOM CRACKING
W/ EFFLORESCENCE

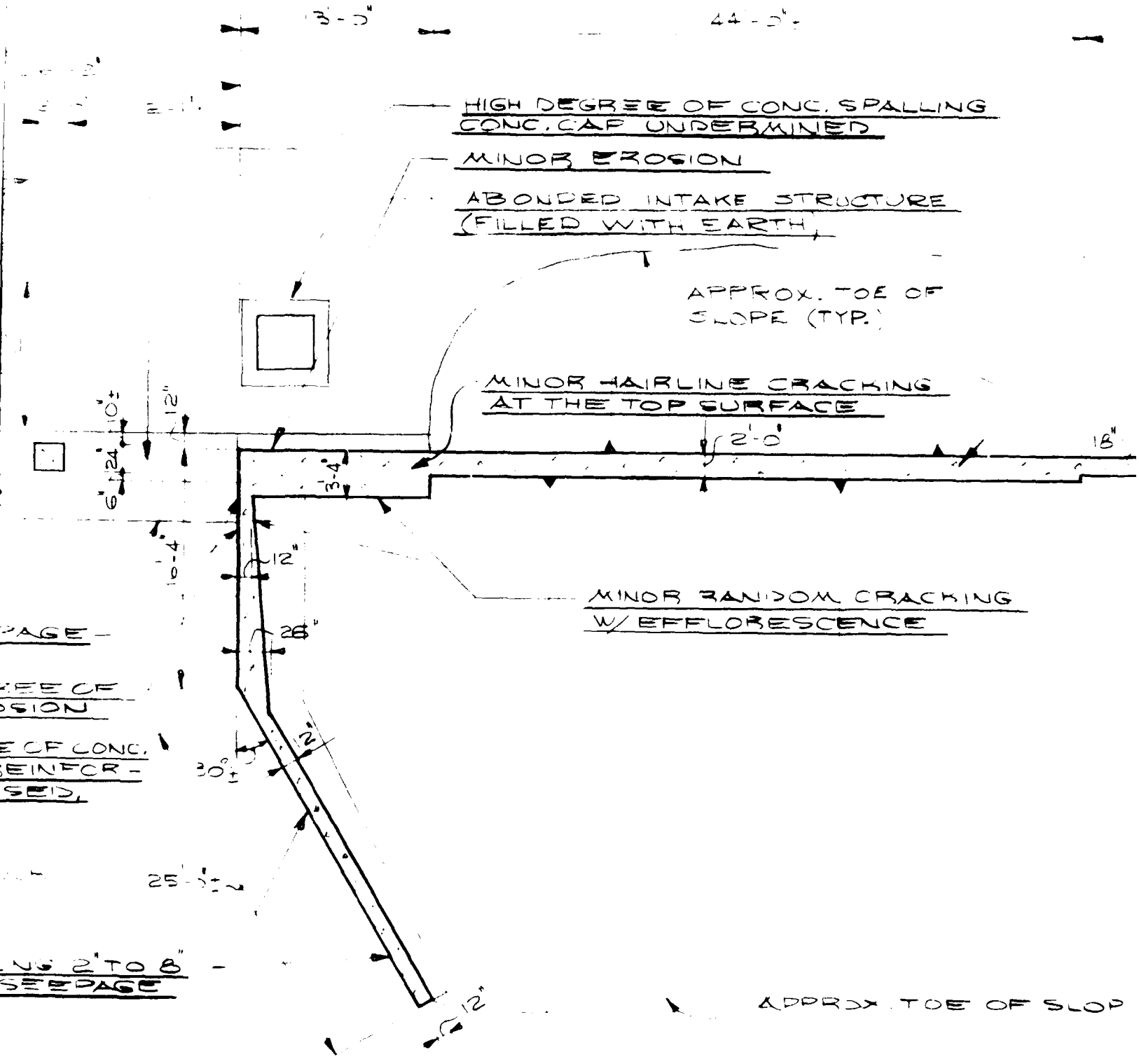
PAGE -

FREE OF
DESIGN

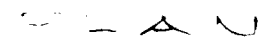
OF CONC.
REINFOR -
SEID,

NG 2' TO 8"
SEE PAGE

APPROX. TOE OF SLOP



23'-0"

SCALE: $1/e'' = 1'' - 0''$

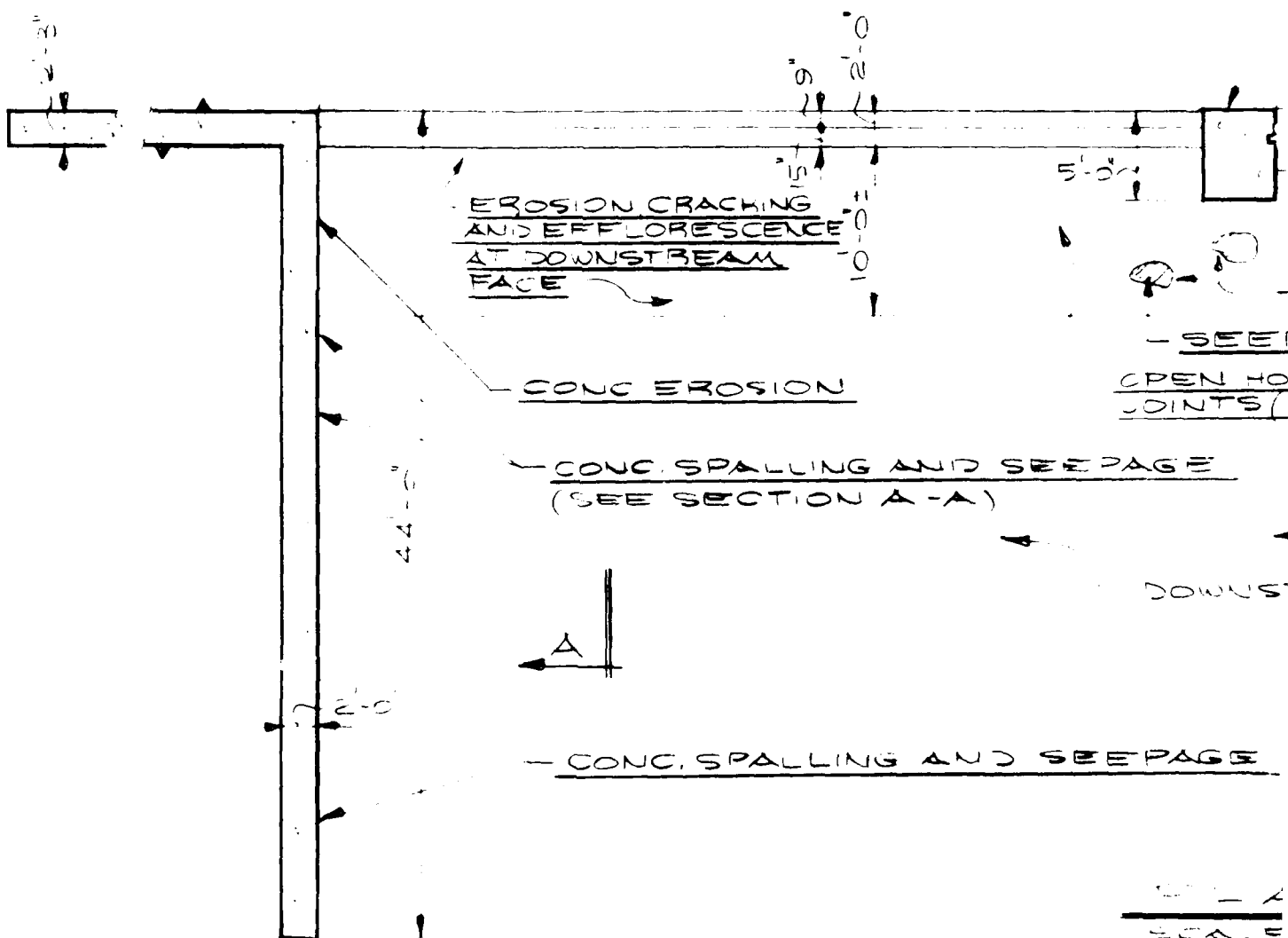
50'-0"

47'-6"

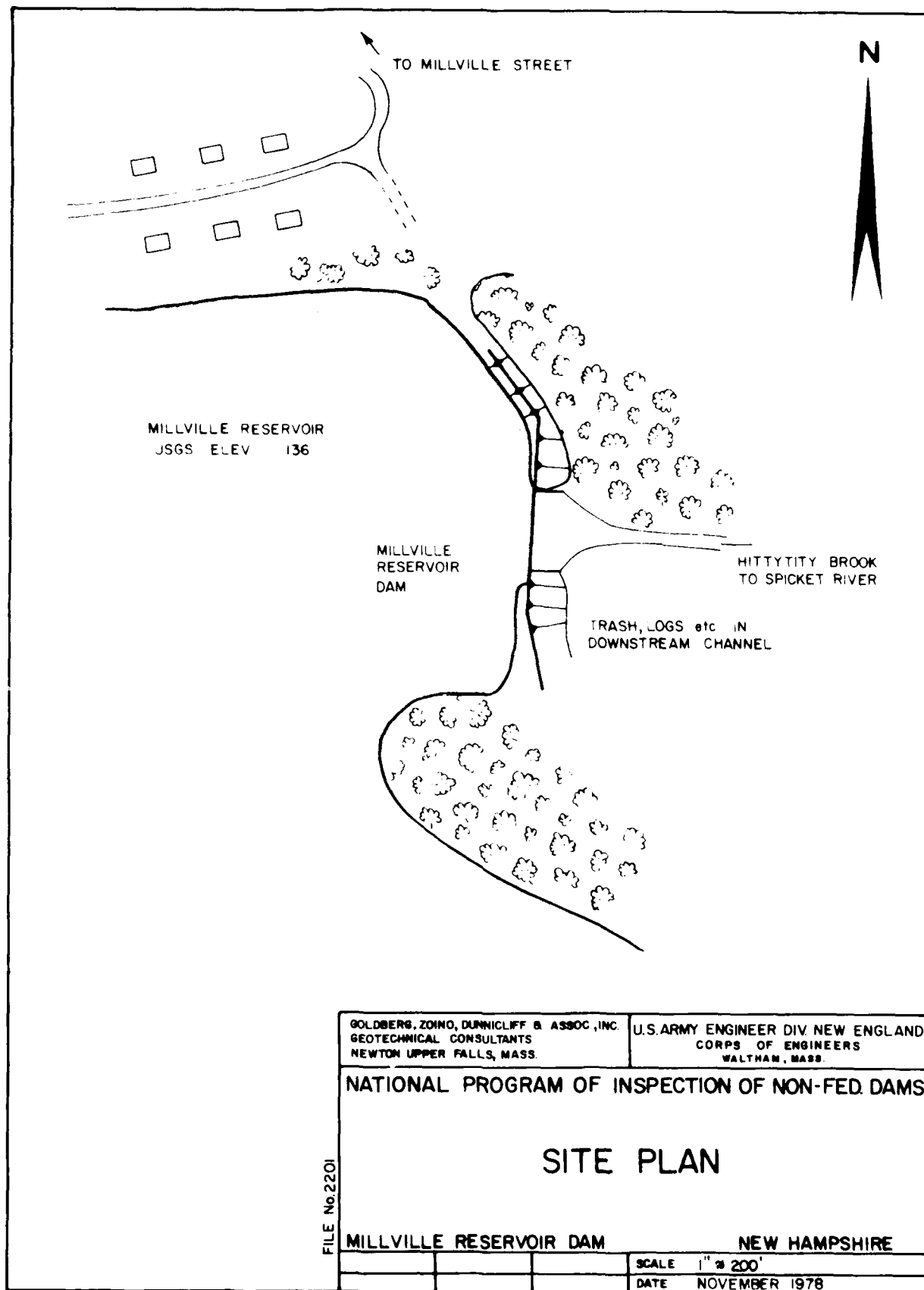
4'-0"



CONC. EROSION AT THE
UPSTREAM FACE OF PIEN



SCALE



APPENDIX B

| | <u>Page</u> |
|---|-------------|
| FIGURE 1 Site Plan | B-2 |
| FIGURE 2 Plan of Jar | B-3 |
| FIGURE 3 Downstream Elevation | B-4 |
| FIGURE 4 Sections of Jar | B-5 |
| Plan of Jar | B-6 |
| List of Pertinent Data not
Included and Their Location | B-7 |

CHECK LISTS FOR VISUAL INSPECTION

| AREA EVALUATED | FY | CONDITION & REMARKS |
|--------------------------------|----|---|
| B. Waste Gate Outlet Structure | | |
| Condition of concrete | AC | Very poor |
| Spalling | | Intensified downstream. Right face spalled over 75% of face up to 5' deep. Downstream right corner spalled. Left face to abutment spillway crest up to 12" thick. Top surface completely spalled. |
| Rebar | | Left downstream corner exposed. 12" high x 18" wide x 16" deep. |
| Cracking | | High degree of random cracking over entire left face. |
| Porting or staining | | Back face stained. Exposed reinforcement. |
| Visible reinforcement | | Exposed rusted wires with fabric over 75% of back face. |
| Efflorescence | | Left face highly efflorescent. |
| Seepage | | Through and around turbine sluice gate at the rate of 1 to 10 gpm. |
| Corrosion | | Five rusted through 18" high and 6" high at both sides of downstream channel water line. |
| Sluice gate | | Operable but not operate. Handwheel not available. No provisions for trash racks or stoplogs. |
| C. Overflow Structure | | |
| Condition of concrete | AC | Structure abandoned. Subject to differential settlement in the range of 6". Filled with earth. |

MILLVILLE RESERVOIR DAM
Salmon, N.H.

NH 00060
November 1, 1978

| CHECK LISTS FOR VISUAL INSPECTION | | |
|-----------------------------------|---------|--|
| AREA EVALUATED | BY | CONDITION & REMARKS |
| Cracks | PE
1 | Five (5) open horizontal joints and one open vertical construction joint |
| Rustiness or staining of concrete | | None noted |
| Visible joint seal | | None noted |
| Efflorescence | | None noted |
| Seepage | | Seepage flowing at interface of spillway and abutment at rate of 1 to 2 gpm |
| Condition of concrete surface | | None |
| Spalling | | 4" x 8" x 16" concrete spalled at downstream toe of spillway |
| Rebar | | See Spalling |
| Cracks | | Random horizontal and vertical cracks over entire abutment face |
| Rustiness or staining of concrete | | None noted |
| Visible joint seal | | None noted |
| Efflorescence | | High degree of efflorescence and oxidation at spillway areas. Minor at random vertical and horizontal cracks |
| Seepage | 1
PE | Along entire interface of abutment and spillway at the rate of 1 to 2 gpm |

MILLVILLE RISINGWATER DAM
 State, N.H.

NH 00030
 November 1, 1978

| CHECK LISTS FOR VISUAL INSPECTION | | |
|-----------------------------------|----|---|
| AREA EVALUATED | BY | CONDITION & REMARKS |
| Spillway | FR | |
| Abutment | | |
| Intermediate pier | | |
| Condition of concrete | | 1. 2' high x 11' deep and 1' high x 11' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Spalling | | See spalling. Interim. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Erosion | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Condition of concrete | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Spalling | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Erosion | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Condition of concrete | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Spalling | FR | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Erosion | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |
| Condition of concrete | | Horizontal construction joint. 1. 2' high x 11' deep. 2. 2' high x 11' deep. 3. 2' high x 11' deep. 4. 2' high x 11' deep. |

MINIMUM INSPECTION
SALON, N.H.

NH 00036
November 1, 1975

CHECK LISTS FOR VISUAL INSPECTION

| AREA EVALUATED | BY | CONDITION & REMARKS |
|-----------------------|----|--|
| Cracks | AC | Two full height diagonal cracks at interior of abutment and downstream in main wall. Minor hairline and random cracks in concrete floor of abutment. |
| Foundation Settlement | | None noted. |
| Abutment Settlement | | None noted. |
| Foundation | | Minor cracks in concrete abutment. |
| Spillway | | Steady seepage at base of location. Concrete spillway apron located upstream of training wall and downstream of length of spillway. No visible erosion or scour. |
| Foundation | | None. |
| Foundation Settlement | | None. |
| Abutment | | Interior concrete abutment. |
| Spillway | | Interior concrete abutment. |
| Foundation | | None noted. |
| Abutment | | Interior concrete abutment. |
| Foundation | | None noted. |
| Abutment | | None noted. |
| Spillway | AC | None noted. |

TOP
CORE
AT THE TOP SURFACE

MINOR RANDOM CRACKING
/ EFFLORESCENCE

NOTE

NOTES

1. DAM INSPECTED ON NOVEMBER 1, 1978 BY GOLDBERG, ZOINO, DUNNICLIFF
AND ASSOC., INC

| | | | |
|--|--|--|---------------|
| GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS | | U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS | |
| NATIONAL PROGRAM OF INSPECTION OF NON-FEED DAMS | | | |
| FIGURE 3 | | | |
| DOWNSTREAM ELEVATION | | | |
| MILLVILLE RESERVOIR DAM | | NEW HAMPSHIRE | |
| | | SCALE | 1/8" = 1' |
| | | DATE | NOVEMBER 1978 |

TOP OF A2

CRACKS
SPALLS

OPEN HORIZONTAL
CONST JOINTS W/
EFFLORESCENCE

EROSION
CRACKING
EFFLORE
TYPE TO
FACE

VERTICAL CRACK
W/ EFFLORESCENCE

AS - 30' OCT OF
DOWNSTREAM CHANNEL

COOL SPALLING UP TO 12"
IN DEPTH W/ SEEPAGE

24"

12"

SECTION
SCALE

2'-0"
9'-15"

WATER SURFACE AT
THE TIME OF INSPECTION
(UP TO ALL SECTIONS)

TOP OF C
PEDEST

ABUTMENT

DOWN
SLOPING AND
FLORESCENCE
TO THIS
LINE

INTERFACE
SPILLWAY

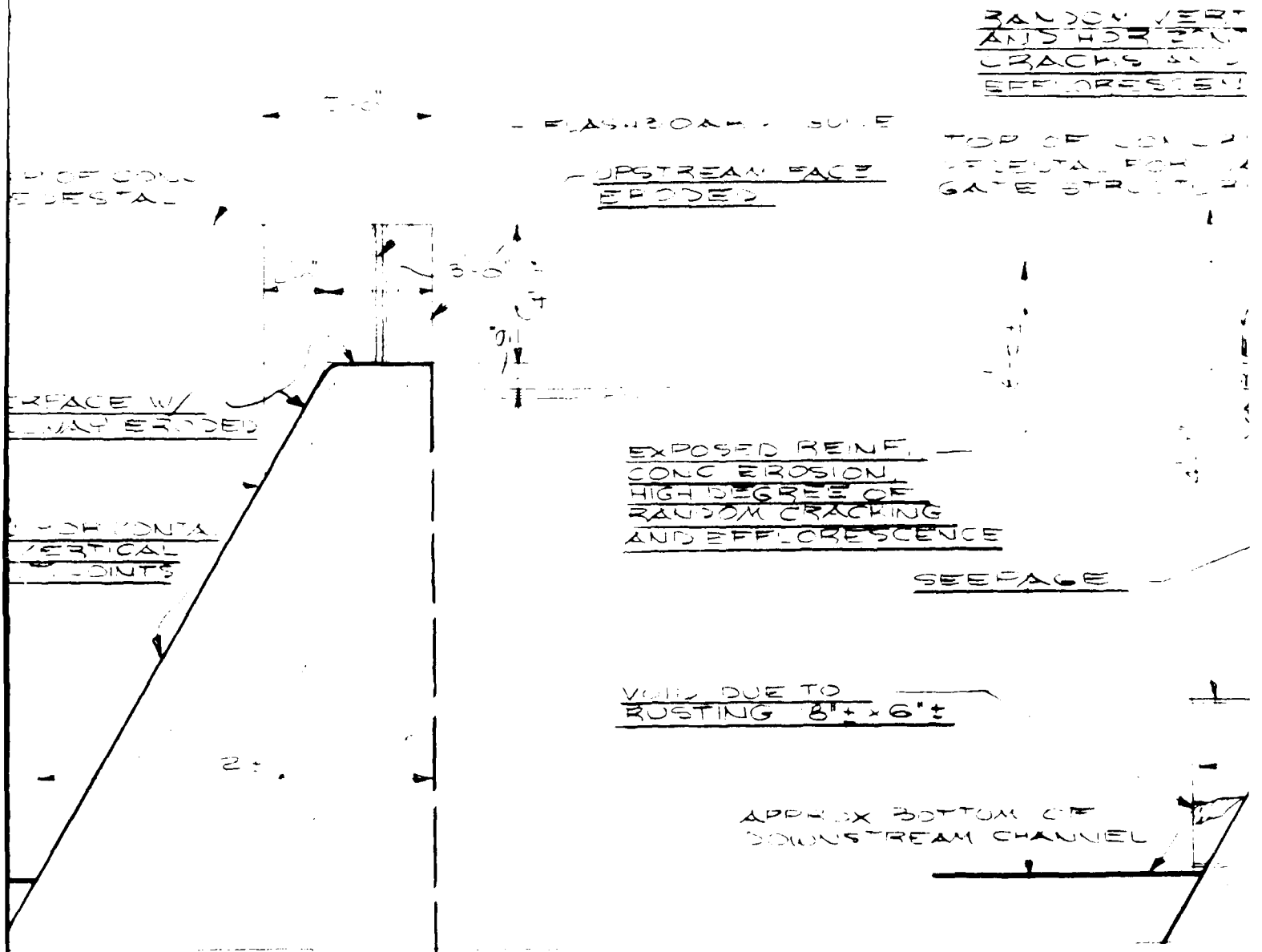
OPEN HORIZ
AND VERTIC
CONJUNCTION

APPROX BOTTOM OF
DOWNSTREAM CHANNEL

SECTION A-A

1/4" = 1'-0"

SECTION
SCALE



SECTION B-B

SCALE 1/4" = 1'-0"

SECTION

SCALE

VERT
ORIGINAL
ELEVATION

CONCRETE
PIER
STRUCTURE

VALUES

EL

4' 0" SLUICE GATE

- PRESENT SPILLWAY CAPPING

WATER LEVEL ON NOV. 1, 1978

TOP OF TRAILING WALL

- APPROX ORIGINAL SPILLWAY CONFIGURATION

ASSUMED BACK FACE OF STRUCTURE (TYP TO ALL SECTIONS)

TIMBER SLUICE GATE

TOP OF SILT

BOT OF UPSTREAM INTAKE CHANNEL

14'

NOTES

SECTION C-C

SCALE 1/4" = 1'-0"

CA-1111G

NOV 1 1978

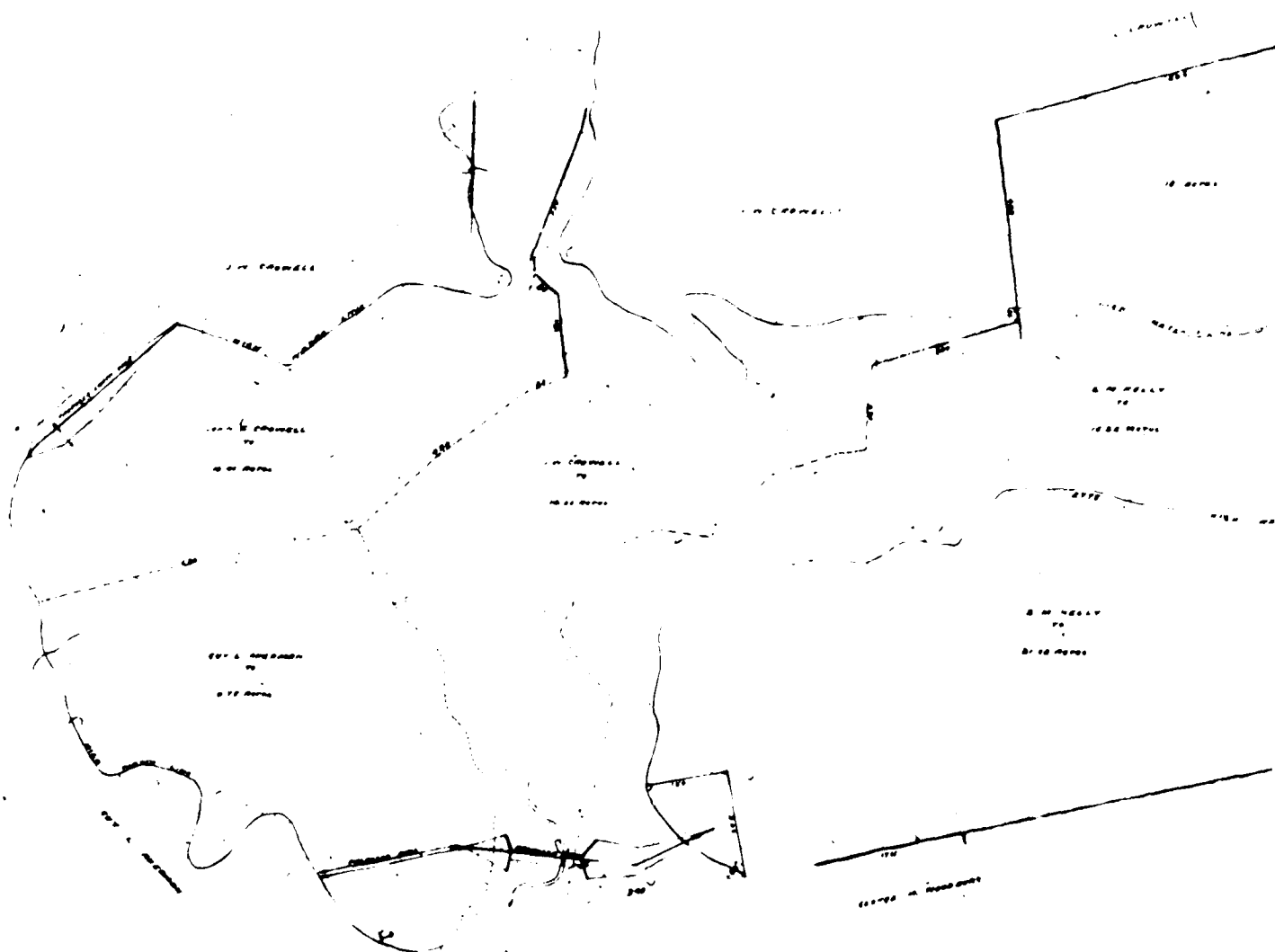
SECTION 4

1A

NOTES

- 1. DAM INSPECTED ON NOVEMBER 1, 1978 BY GOLDBERG, ZOINO, DUNNICLIFF AND ASSOC., INC.

| | | | |
|--|--|---|---------------|
| GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS | | U.S. ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS | |
| NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS | | | |
| FIGURE 4 | | | |
| SECTIONS OF DAM | | | |
| MILLVILLE RESERVOIR DAM | | NEW HAMPSHIRE | |
| | | SCALE | 1/8" = 1' |
| | | DATE | NOVEMBER 1978 |

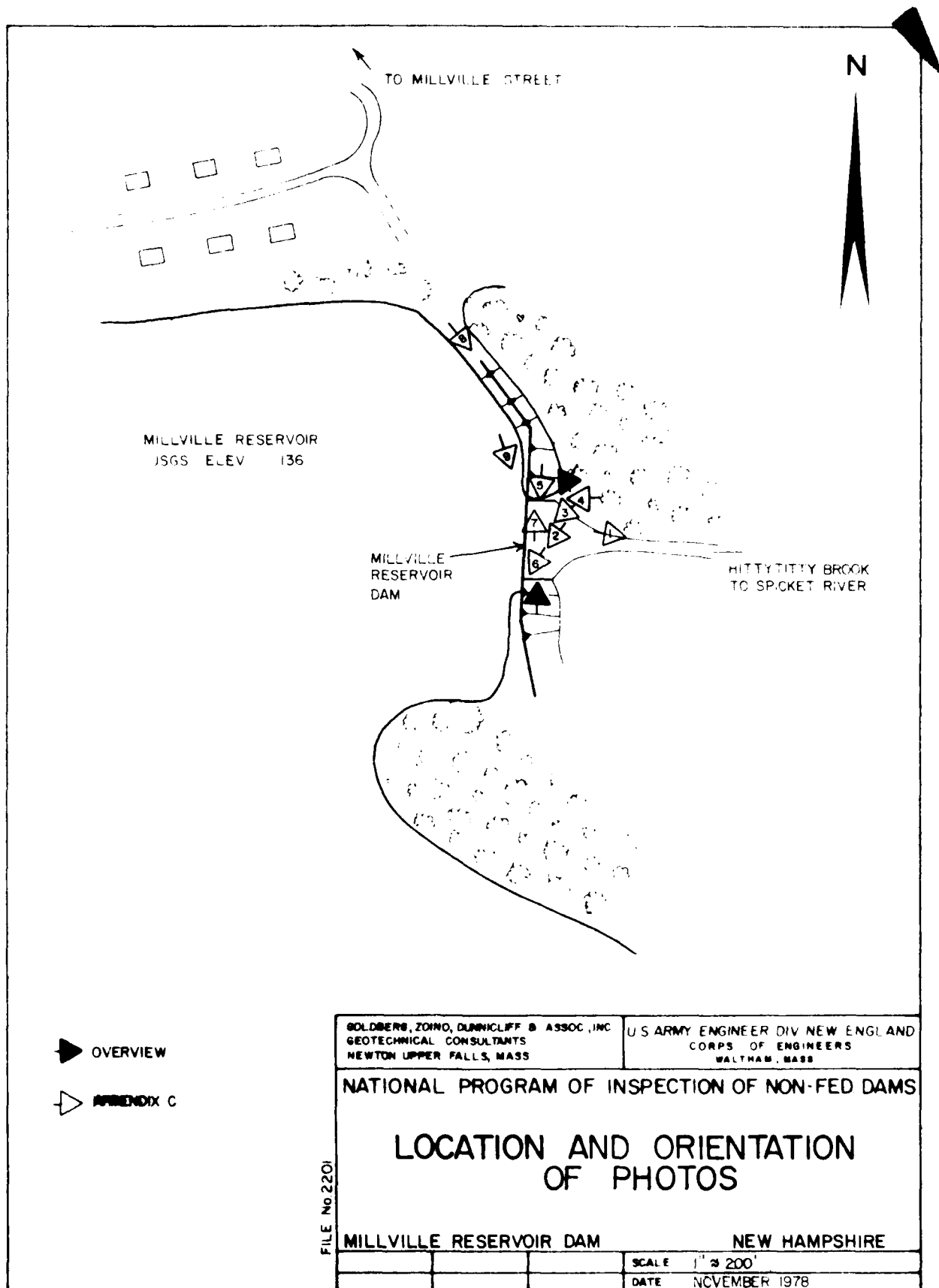


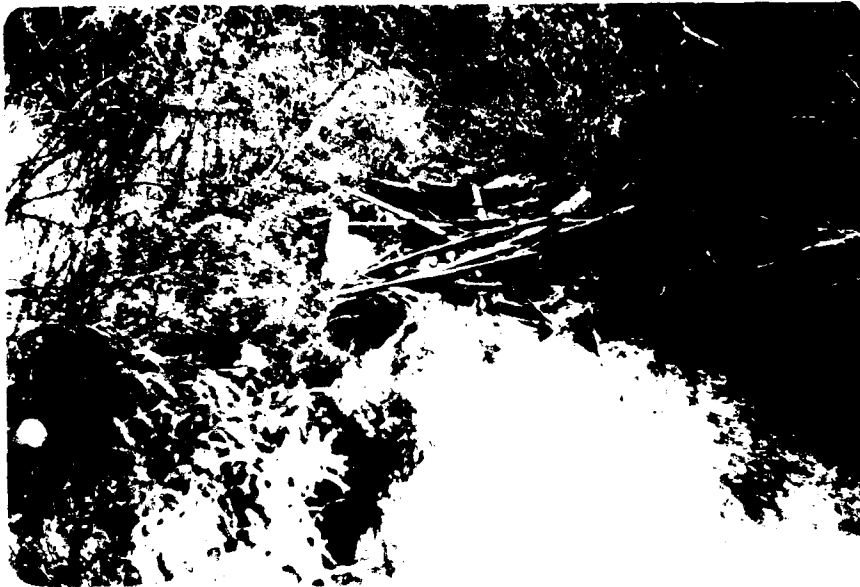
MILLVILLE RESERVOIR

The New Hampshire Water Resources Board (NHWRB) located at 37 Pleasant Street, Concord, N.H. 03301 maintains a comprehensive record of the data included in this report.

1. Inspection reports dated June 25, 1943; July 17, 1943; 1944; December 1, 1944; August 13, 1968; August 19, 1971; November 17, 1971; and October 6, 1972.
2. "The New Hampshire Water Control Commission's Study of Dams in New Hampshire" (July 10, 1968).
3. "The NHWRB Inventory of Dams and Water Use Developments" (October 30, 1967).
4. "Public Service Commission's of New Hampshire" (October 6, 1967).
5. Construction sketches and specifications of the dam.
6. Calculation of dam stability from a 1967 study.

ANNEX
SCHEDULE 1





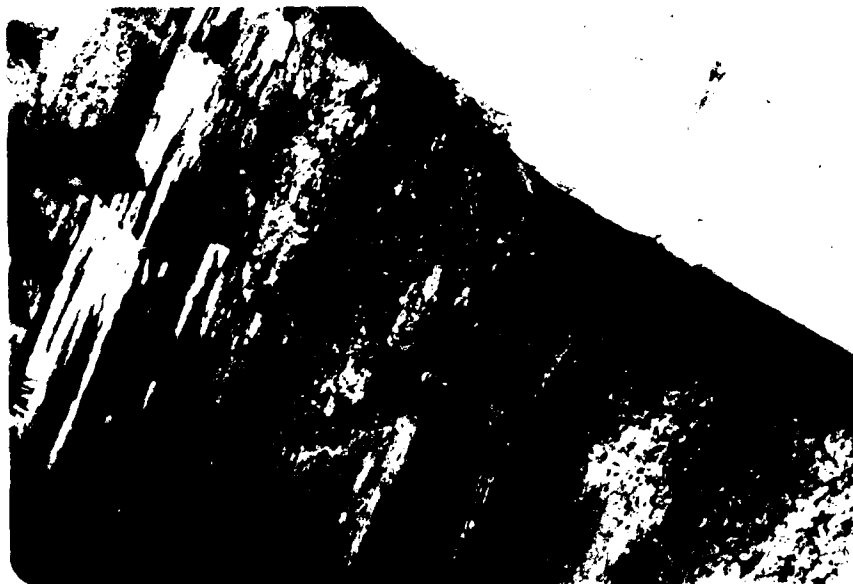
1. View from dam of large quantity of debris in downstream channel



2. View from downstream channel of concrete deterioration on right side of spillway



3. View from downstream channel of concrete deterioration on middle section of spillway



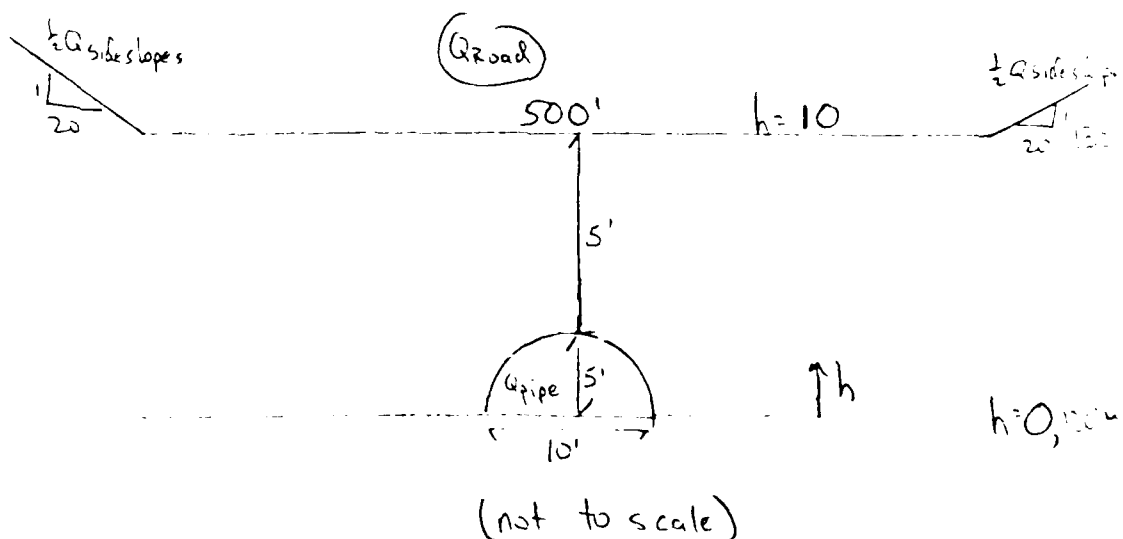
4. View from downstream channel of concrete deterioration on left side of spillway

Dam Failure Analysis

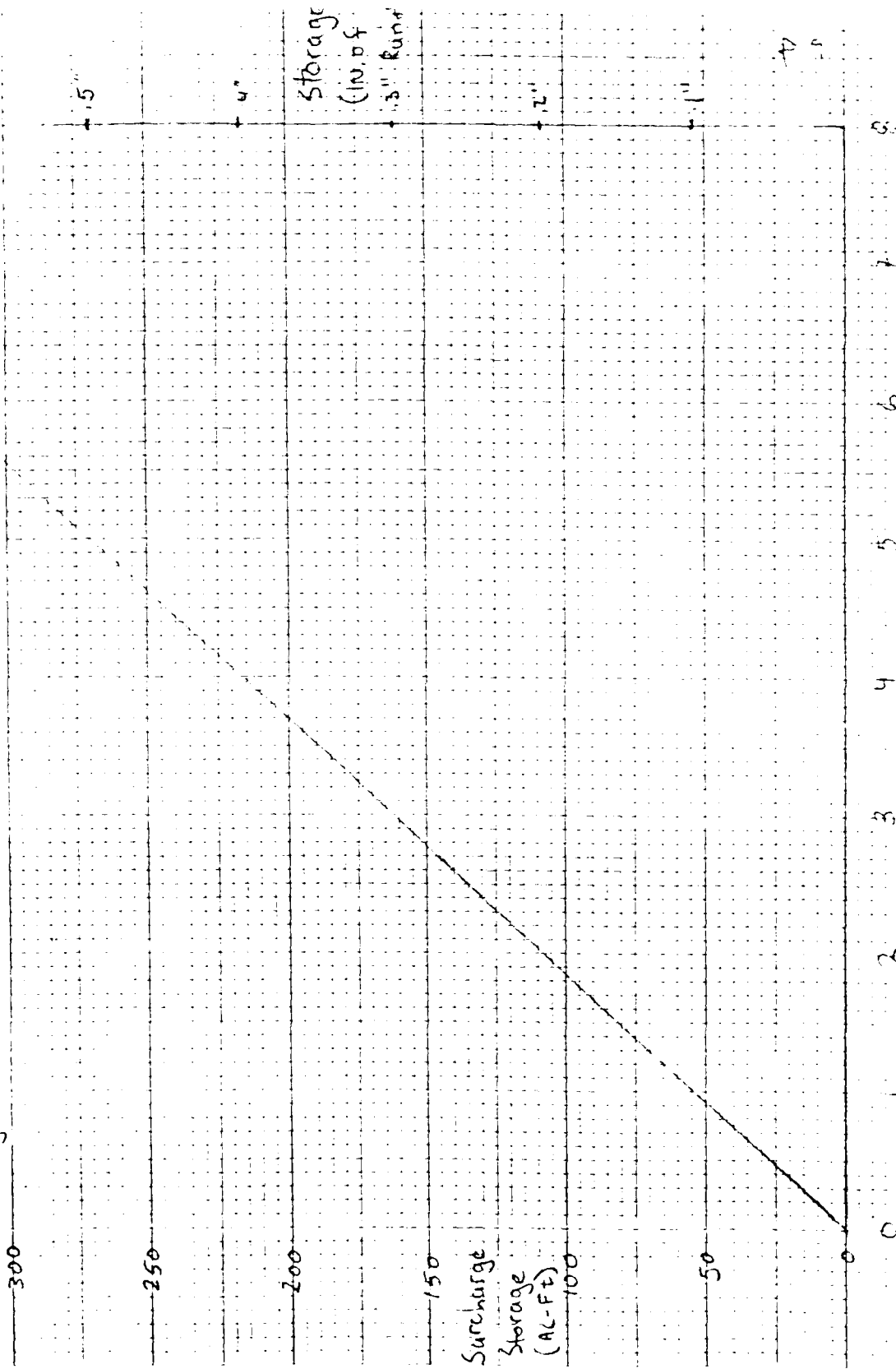
Assume that the dam fails when the water reaches the left abutment, $h = 3.4'$ (elevation = 139.4' MSL). From the Stage-discharge curve, this would require a discharge of 1050 cfs.

It is necessary to determine the tailwater elevation from this flow.

Tailwater at the dam at high flows is controlled by a culvert in Pine Grove Park development, some 2400' downstream of the dam. (see map, p. 11 the culvert is ①). This culvert consists of a 10' diameter circular metal pipe. The pipe is half-full of dirt and debris. The top of the pipe is about 5' below the road surface. The roadway is at about U.S.G.S. elevation 130' MSL.



Storage-Elevation Curve at Millville Reservoir Dam



Elevation (feet above sea level)

Storage-Elevation Curve

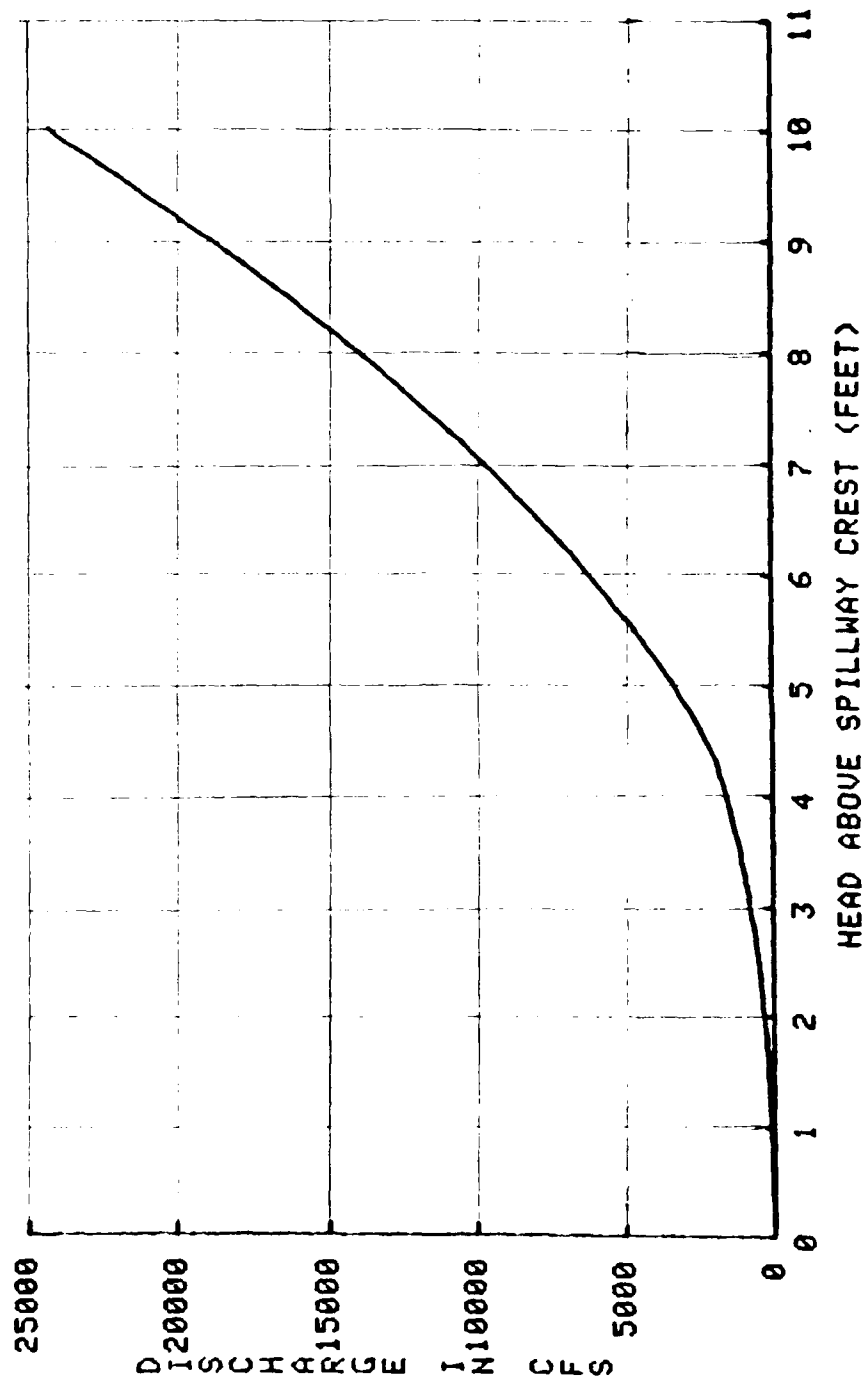
The storage-elevation curve for Millville Reservoir Dam is given on p. 9. This curve is based on a surface area of 54 acres and the assumption that the pond does not spread as it rises.

1" of runoff over 10.1 sq. mi.

$$\rightarrow 1" (10.1) \left(640 \frac{\text{acres}}{\text{sq. mi.}} \right) \left(\frac{1 \text{ ft}}{12 \text{ in.}} \right) = 538.7 \text{ ac-ft.}$$

$$\rightarrow 1 \text{ ft of rise} = \frac{1 (54 \frac{\text{Ac-ft}}{\text{ft}})}{538.7 (\text{Ac-ft/in})} = 1/10 \text{ of runoff}$$

STAGE-DISCHARGE CURVE AT MILLVILLE RESERVOIR DAM



P.7

DISCHARGE FROM MILLVILLE RESERVOIR DAM AS A FUNCTION OF HEAD

| HEAD
(FEET) | TOTAL | DISCHARGE
(CFS) | | MIDDLE
OF DAM | SPILLWAYS |
|----------------|-------|--------------------|---------------|------------------|-----------|
| | | LEFT
BANK | RIGHT
BANK | | |
| 0.00 | 0 | 0 | 0 | 0 | 0 |
| 0.25 | 11 | 0 | 0 | 0 | 11 |
| 0.50 | 32 | 0 | 0 | 0 | 32 |
| 0.75 | 59 | 0 | 0 | 0 | 58 |
| 1.00 | 90 | 0 | 0 | 0 | 90 |
| 1.25 | 126 | 0 | 0 | 0 | 126 |
| 1.50 | 165 | 0 | 0 | 0 | 165 |
| 1.75 | 208 | 0 | 0 | 0 | 228 |
| 2.00 | 270 | 0 | 0 | 0 | 310 |
| 2.25 | 406 | 0 | 0 | 0 | 406 |
| 2.50 | 513 | 0 | 0 | 0 | 513 |
| 2.75 | 635 | 0 | 0 | 0 | 635 |
| 3.00 | 776 | 0 | 0 | 0 | 776 |
| 3.25 | 933 | 0 | 0 | 0 | 933 |
| 3.50 | 1107 | 0 | 5 | 0 | 1102 |
| 3.75 | 1318 | 0 | 36 | 0 | 1282 |
| 4.00 | 1554 | 0 | 91 | 0 | 1473 |
| 4.25 | 1822 | 0 | 138 | 2 | 1674 |
| 4.50 | 2223 | 119 | 206 | 13 | 1884 |
| 4.75 | 2714 | 297 | 284 | 29 | 2104 |
| 5.00 | 3276 | 523 | 372 | 49 | 2332 |
| 5.25 | 3893 | 789 | 465 | 72 | 2568 |
| 5.50 | 4576 | 1091 | 575 | 98 | 2812 |
| 5.75 | 5305 | 1425 | 699 | 125 | 3064 |
| 6.00 | 6083 | 1789 | 812 | 158 | 3323 |
| 6.25 | 6907 | 2182 | 944 | 192 | 3589 |
| 6.50 | 7776 | 2601 | 1084 | 227 | 3863 |
| 6.75 | 8688 | 3047 | 1233 | 265 | 4143 |

P.6

DISCHARGE FROM MILLVILLE RESERVOIR DAM AS A FUNCTION OF HEAD

| HEAD
(FEET) | TOTAL | DISCHARGE
(CFS) | | MIDDLE
OF DAM | SPILLWAYS |
|----------------|-------|--------------------|---------------|------------------|-----------|
| | | LEFT
BANK | RIGHT
BANK | | |
| 0.5 | 0 | 0 | 0 | 0 | 0 |
| 0.5 | 32 | 0 | 0 | 0 | 32 |
| 1.0 | 90 | 0 | 0 | 0 | 90 |
| 1.5 | 165 | 0 | 0 | 0 | 165 |
| 2.0 | 310 | 0 | 0 | 0 | 310 |
| 2.5 | 513 | 0 | 0 | 0 | 513 |
| 3.0 | 776 | 0 | 0 | 0 | 776 |
| 3.5 | 1102 | 0 | 0 | 0 | 1102 |
| 4.0 | 1473 | 0 | 0 | 0 | 1473 |
| 4.5 | 1884 | 0 | 0 | 13 | 1884 |
| 5.0 | 2332 | 119 | 81 | 49 | 2332 |
| 5.5 | 2812 | 523 | 206 | 98 | 2812 |
| 6.0 | 3323 | 1091 | 575 | 158 | 3323 |
| 6.5 | 3863 | 1789 | 912 | 227 | 3863 |
| 7.0 | 4430 | 2691 | 1084 | 304 | 4430 |
| 7.5 | 5023 | 3517 | 1391 | 388 | 5023 |
| 8.0 | 5642 | 4530 | 1732 | 470 | 5642 |
| 8.5 | 6284 | 5634 | 2107 | 575 | 6284 |
| 9.0 | 6949 | 6826 | 2516 | 677 | 6949 |
| 9.5 | 7637 | 8103 | 2961 | 784 | 7637 |
| 10.0 | 8346 | 9462 | 3441 | 897 | 8346 |
| 10.5 | 9077 | 10901 | 3956 | 1015 | 9077 |
| 11.0 | 9827 | 12419 | 4508 | 1137 | 9827 |
| 11.5 | 10598 | 14014 | 5096 | 1264 | 10598 |
| 12.0 | 11387 | 15695 | 5721 | 1396 | 11387 |
| 12.5 | 12196 | 17432 | 6384 | 1531 | 12196 |
| 13.0 | 13023 | 19253 | 7085 | 1671 | 13023 |
| 13.5 | 43666 | 21148 | 7824 | 1815 | 13668 |
| | 47401 | 23116 | 8602 | | |

D.S

```

440 Q9=2.8*10*(H-4.2)*(0.5*(H-4.2))↑1.5
450 T1=Q1+Q2
460 T2=Q9+Q8
470 T3=T1+T2+Q3+Q4+Q5+Q6+Q7
480 T4=Q3+Q4+Q5
490 T5=Q6+Q7
500 PRINT USING 510:H,T3,T2,T1,T5,T4
510 IMAGE 17,20,20,140,110,130,160
520 NEXT H
530 END

```

P.4

P.3

```

1100 REM: STAGE DISCHARGE PROGRAM FOR MILLVILLE RESERVOIR DAM, JOB 163
1110 REM: ON TAPE 10, FILE 82
1120 PAGE
1130 PRINT "DISCHARGE FROM MILLVILLE RESERVOIR DAM AS A FUNCTION OF HEAD"
1140 PRINT USING 150:
1150 IMAGE > 2T"HEAD"30T"DISCHARGE"
1160 PRINT USING 170:
1170 IMAGE 1T"(FEET)"32T"(CFS)"
1180 PRINT USING 190:
1190 IMAGE 15T"TOTAL"7X"LEFT"7X"RIGHT"7X"MIDDLE"7X"SPILLWAYS"
1200 PRINT USING 210:
1210 IMAGE 27T"BANK"7X"BANK"8X"OF DAM"
1220 FOR H=0 TO 6.75 STEP 0.25
1230 Q1=0
1240 Q2=0
1250 Q3=0
1260 Q4=0
1270 Q6=0
1280 Q7=0
1290 Q8=0
1300 Q9=0
1310 Q5=3*30*H↑1.5
1320 IF H<1.5 THEN 450
1330 Q4=3.3*47.6*(H-1.5)↑1.5
1340 IF H<2.6 THEN 450
1350 Q3=3.3*24.2*(H-2.6)↑1.5
1360 IF H<3.4 THEN 450
1370 Q2=2.8*60*(H-3.4)↑1.5
1380 Q1=2.8*10*(H-3.4)*(0.5*(H-3.4)↑1.5
1390 IF H<4.1 THEN 450
1400 Q6=3*8*(H-4.1)↑1.5
1410 IF H<4.2 THEN 450
1420 Q7=3*13.2*(H-4.2)↑1.5
1430 Q8=3*241*(H-4.2)↑1.5

```

1.5 Dam Safety

4. Lake Reservoir Dam

-(6 3/5) p 2

for $h = 2.6$ to 3.4

$$Q_3 = 3.3 (24.2) (h - 2.6)^{3/2}$$

all others unchanged

for $h = 3.4$ to 4.1

$$Q_2 = 2.8 (60) (h - 3.4)^{3/2}$$

$$Q_1 = 2.8 (10) (h - 3.4) (.5 (h - 3.4))^{3/2}$$

all others unchanged

for $h = 4.1$ to 4.2

$$Q_6 = 30 (8) (h - 4.1)^{3/2}$$

all others unchanged

for $h = 4.2$ and above

$$Q_7 = 30 (13.2) (h - 4.2)^{3/2}$$

$$Q_8 = 30 (241) (h - 4.2)^{3/2}$$

$$Q_9 = 2.8 (10) (h - 4.2) (.5 (h - 4.2))^{3/2}$$

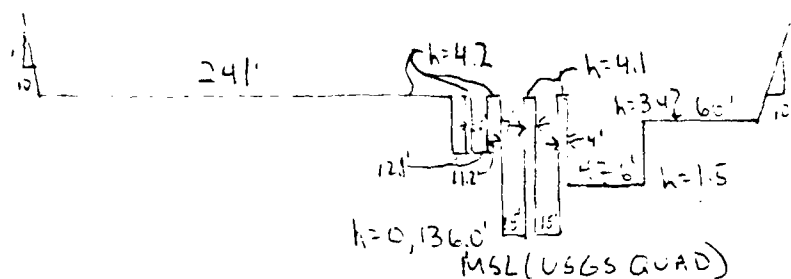
all others unchanged.

Broad-crested
earth weir,
 $C = 2.8$

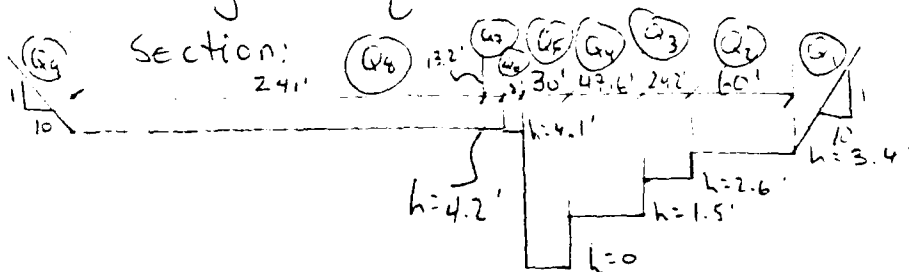
A BASIC program to calculate the stage-discharge relationship follows on pp. 3-7.

Stage-Discharge Curve

The information used to establish the cross section at Millville Reservoir Dam was determined from field notes and old plans:



The discharge is equivalent to that over this cross-



No operable gates

for $h=0$ to 1.5

$$Q_5 = 3 (30) h^{3/2}$$

$$Q_1 = Q_2 = Q_3 = Q_4 = Q_6 = Q_7 = Q_8 = Q_9 = 0$$

for $h=1.5$ to 2.6

$$Q_4 = 3.3 (47.6) (h-1.5)^{3/2}$$

all others unchanged ^{D-2}

Broad-crested
concrete weir
 $C=3.0$

At our flow of
interest, there is
a sharp-crested
weir, $C=3.2$

APPENDIX D
HYDROLOGIC/HYDRAULIC COMPUTATIONS

8. View of left embankment and
concrete core wall



9. View of abandoned intake structure
and upstream side of left spill-
way end structure



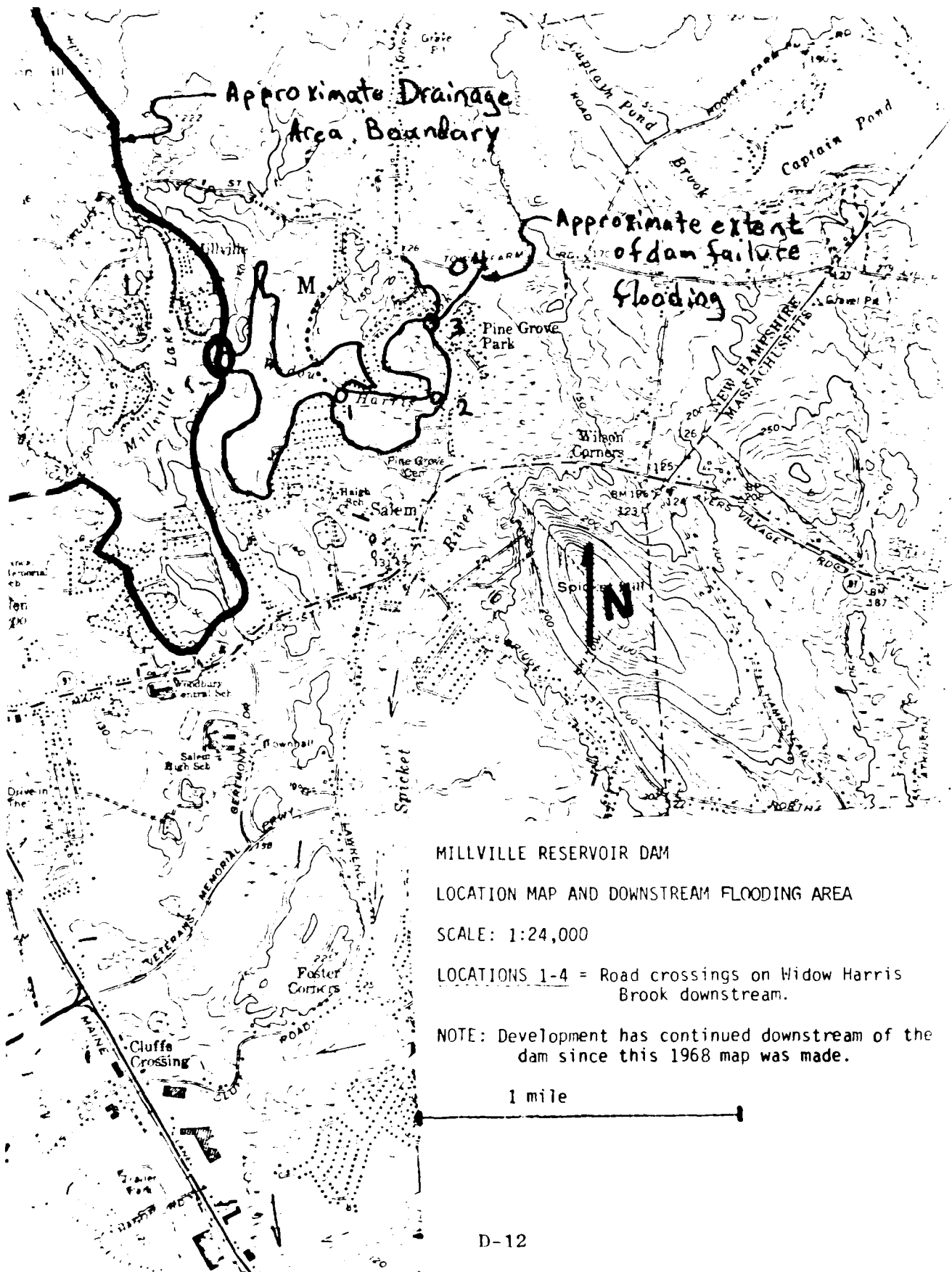
7. View from downstream channel of deteriorated concrete and seepage through left endwall



5. View from left endwall of concrete deterioration on gate structure exposing reinforcement



6. View from downstream channel of deteriorated concrete and seepage through right endwall



MILLVILLE RESERVOIR DAM

LOCATION MAP AND DOWNSTREAM FLOODING AREA

SCALE: 1:24,000

LOCATIONS 1-4 = Road crossings on Widow Harris Brook downstream.

NOTE: Development has continued downstream of the dam since this 1968 map was made.

1 mile

Flows through the culvert were estimated using a nomograph is FHWA Hydraulic Engineering Circular No. 5, assuming inlet control.

Flow over the roadway was estimated using the weir equation for a broad crested weir with $C=3.0$:

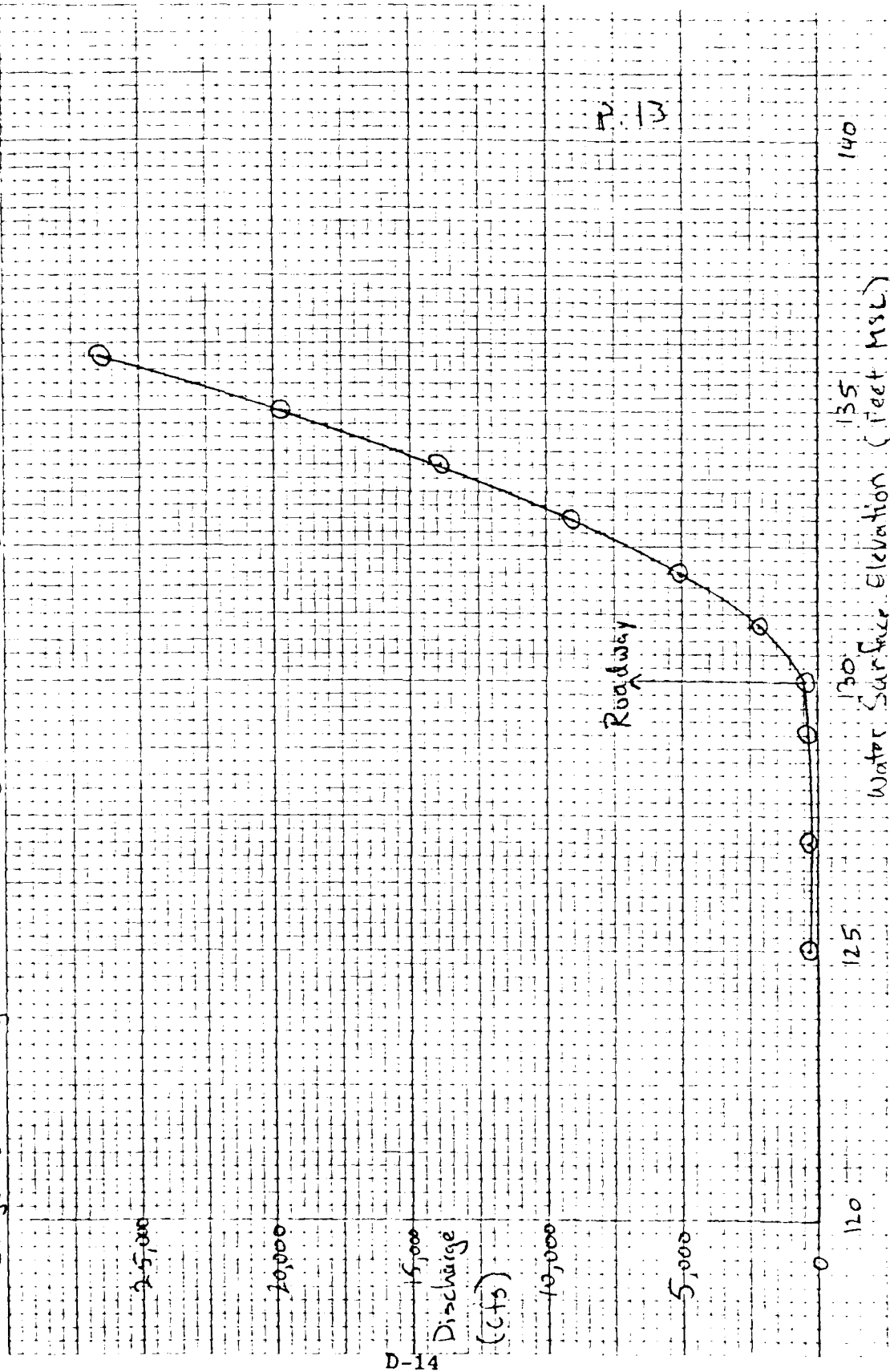
$$Q_{road} = 3(500)(h-10)^{3/2}$$

$$Q_{sideslopes} = 3(20)(h-10)(.5(h-10))^{3/2} + 3(20)(h-10)(.5(h-10))^{3/2}$$

| h (') | y (MSL) | Q_{pipe} (cfs) | Q_{road} (cfs) | $Q_{sideslopes}$ (cfs) | Q_{TOTAL} (cfs) |
|---------|-----------|------------------|------------------|------------------------|-------------------|
| 5 | 125 | 270 | 0 | 0 | 270 |
| 7 | 127 | 370 | 0 | 0 | 370 |
| 9 | 129 | 430 | 0 | 0 | 430 |
| 10 | 130 | 470 | 0 | 0 | 470 |
| 11 | 131 | 490 | 1500 | 42 | 2030 |
| 12 | 132 | 525 | 4243 | 240 | 5010 |
| 13 | 133 | 560 | 7794 | 661 | 9020 |
| 14 | 134 | 585 | 12000 | 1358 | 13940 |
| 15 | 135 | 615 | 16,771 | 2372 | 19,760 |
| 16 | 136 | 640 | 22,045 | 3741 | 26,430 |

The Stage-Discharge curve for this culvert is shown on p. 13.

Stage-Discharge Curve at Culvert 2400' Downstream of Millville Reservoir Dam



165 Dam Safety

Millville Reservoir Dam

TCE, 3/5/73, p. -

Thus, at the pre-failure flow of 1050 cfs, the tailwater elevation at the dam would be about 130.5' MSL, .5' above the roadway.

Peak Failure outflow = normal outflow + breach outflow

Normal outflow:

$$Q = 1050 \text{ cfs for } h = 3.4' \text{ above spillway crest}$$

Breach outflow:

$$Q_{P1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$$

W_b = Width of breach, $\leq .4$ (total width).

$$\text{Assume } W_b = .4 \text{ (length of earth embankment overtopped)} \\ = .4(241) = 96 \text{ ft.}$$

$$y_o = \text{height above tailwater} = (136 + 3.4) - 130.5 = 8.9'$$

$$Q_{P1} = \frac{8}{27} (96) \sqrt{32.2} (8.9)^{3/2} = 4290 \text{ cfs}$$

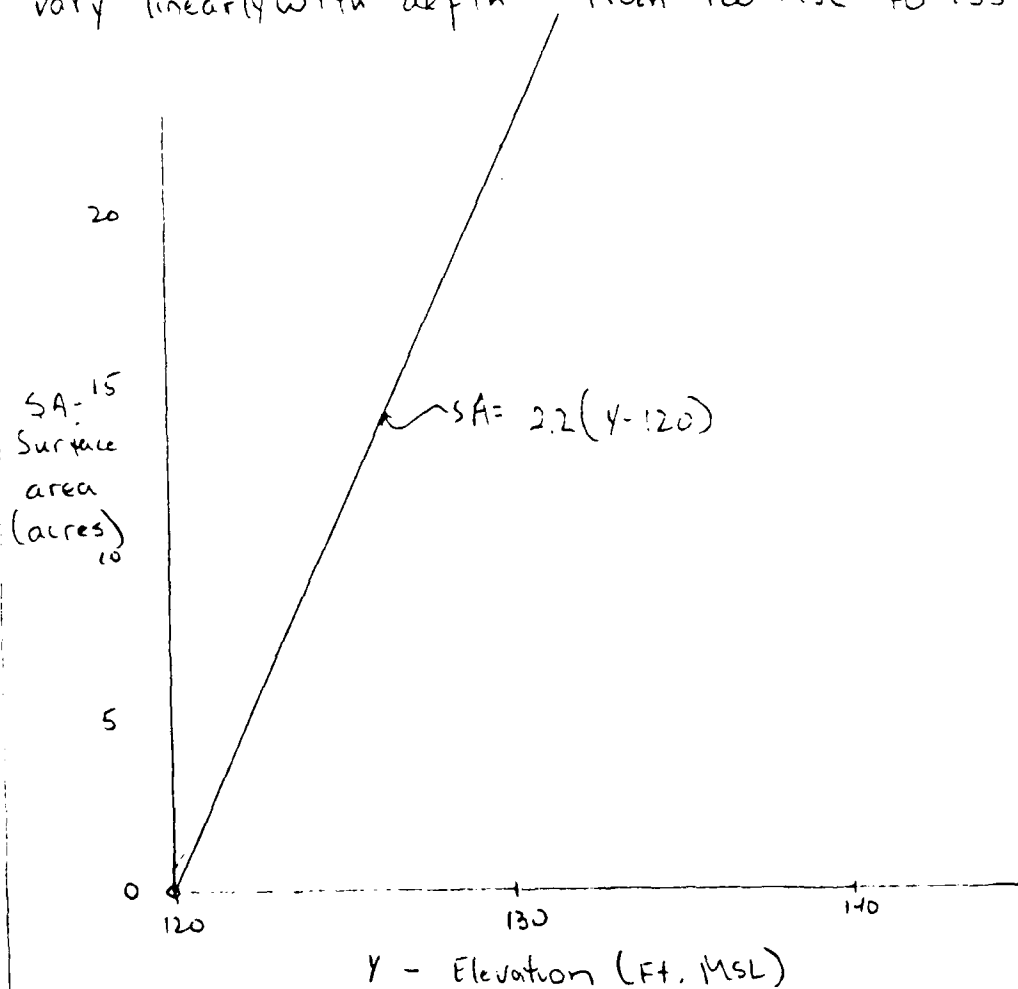
$$\text{Peak outflow} = 1050 + 4290 = 5340 \text{ cfs}$$

We will use the COE's suggested graphical routing method to determine the flow reduction in the first reach, and thus the stage resulting from the failure outflow. To do this, we require the Storage-Elevation relationship for the reach of the Widow Harris River between the dam and the culvert.

105 Dam Safety - Millville Reservoir Dam T.C. 3/1/75, p. 5

This was estimated as follows:

The surface area at water surface elevation = 120' MSL was estimated as 0. The surface area at water surface elevation 130' MSL was estimated by planimeter as 22 acres. The surface area was assumed to vary linearly with depth from 120' MSL to 135' MSL:



The equation for this linear relationship is:

$$S.A. = 2.2(Y - 120)$$

165 Dam Safety Millville Reservoir Dam

TUG, 3/15/79, p. 6

Volume of storage can be determined:

$$V = \int 2.2 (y - 120) dy$$
$$= 1.1 y^2 - 264 y + C$$

at $y = 120$, $V = 0$, so

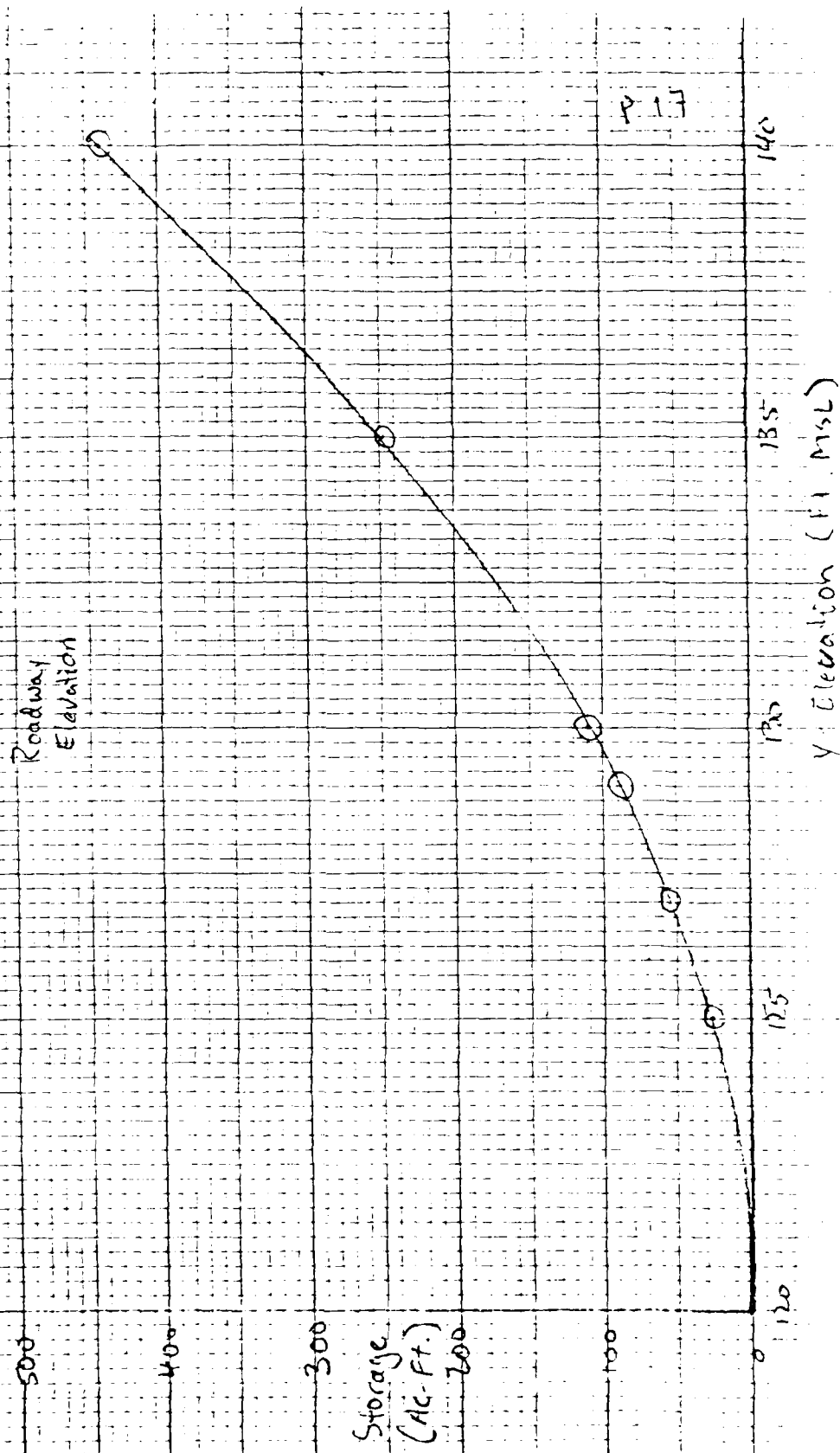
$$C = 264(120) - 1.1(120)^2 = 15,840 \text{ ac-ft}$$

$$V = 1.1 y^2 - 264 y + 15,840$$

| y | V(ac-ft.) | y | V(ac-ft.) |
|-----|-----------|-----|-----------|
| 120 | 0 | 135 | 247.5 |
| 121 | 1.1 | 140 | 440 |
| 122 | 4.4 | | |
| 123 | 9.9 | | |
| 124 | 17.6 | | |
| 125 | 27.5 | | |
| 126 | 39.6 | | |
| 127 | 53.9 | | |
| 128 | 70.4 | | |
| 129 | 89.1 | | |
| 130 | 110 | | |

The Storage-Elevation Curve
for this reach is on p. 17.

Storage behind culvert, Millville Reservoir Dam



Dam Break Routing Through Culvert

$$Q_{P2} = \left(1 - \frac{STOR}{POSS VOL.}\right) Q_{P1}$$

$$Q_{P2} = \left(1 - \frac{STOR}{690}\right) Q_{P1} = \left(1 - \frac{STOR}{690}\right) 5340$$

$$Q_{P2} = \left(1 - \frac{STOR}{690}\right) 5340$$

$POSS VOL. = \text{Volume stored in pond}$
 $at break = 504 ML Ft.$
 $+ 3.4(54) = 690 ML Ft.$

Y Stor Q_{P2} (cfs)

120 0 5340

125 27 5130

Discharge 130 110 4490

(cfs) 135 248 3420

137 158 4120

131 130 4330

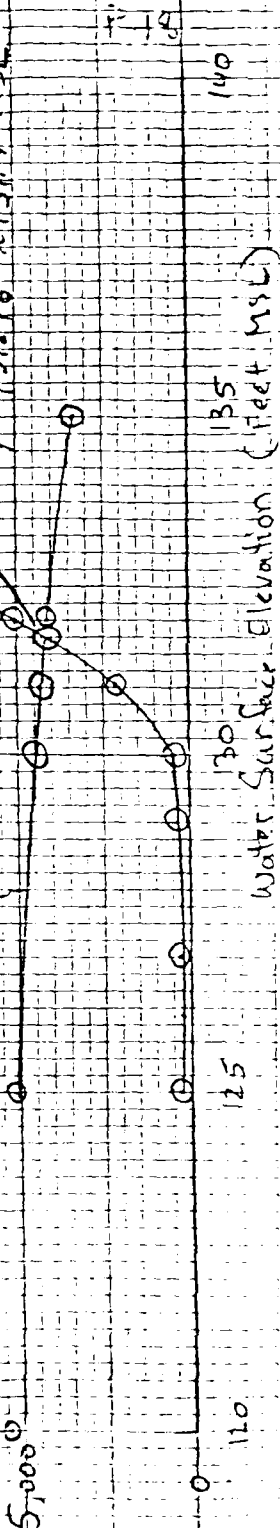
Q_{P2} vs Stages

Roadway

$Q = 4200 cfs$

$V = 131.76 \approx 131.7 MSL$

Stage = Discharge at Culvert



165 Dam Safety Littleville Reservoir Dam TEL 3/15/74

Thus dam failure raises the water level in the first reach by 1.2' to 1.7' above the road. There is extensive development in this area, which is part of the Pine Grove Park subdivision of Salem, New Hampshire. The water level prior to dam failure would cause some flooding, which would be increased significantly by dam failure.

The dam failure outflow would continue to cause such increases in flow and water surface elevation as the failure wave proceeded downstream on the Widow Harris River. The flow would continue to be attenuated by the swampy areas and culverts downstream, but a large increase in flooding would result from dam failure.

165 Dam Safety Millville Reservoir Dam

TCC, 3/15/77: 2.

Test Flood Analysis

Size classification: Small

Hazard classification: Significant

The hazard classification is significant because of the probability of increased downstream flooding in residential areas due to dam failure. The fact that water levels would rise only 1-2 feet, and ^{thus} would not present a large threat of loss of life, makes significant appropriate rather than high.

Test Flood: 100 year to $\frac{1}{2}$ PMF.

Because the hazard is on the high side of significant, we will use the $\frac{1}{2}$ PMF.

The area draining to Millville Reservoir is hilly, with interspersed areas of marsh and several small reservoirs. Thus, using the Corps PMF peak flow rates chart, we selected a flow of 1000 csm for the PMF $\rightarrow 1000/2 = 500$ csm for the $\frac{1}{2}$ PMF.

$$\text{Peak inflow} = 500 \text{ csm} (10.1 \text{ sq. mi.}) = 5050 \text{ cfs.}$$

$$= \frac{19}{2} = 9.5'' \text{ runoff.}$$

$$Q_{P_2} = Q_{P_1} \left(1 - \frac{S_{TOR}}{9.5} \right) = 5050 \left(1 - \frac{S_{TOR}}{9.5} \right)$$

$\frac{S_{TOR}}{0-21}$ in " of runoff.

| h
(' above spillway) | Y
(Ft. MSL) | STOR
(10^6 of runoff) | Q_{P2} |
|---------------------------|------------------|-----------------------------|----------|
| 0 | 136 | 0 | 5050 |
| 2 | 138 | .2 | 4940 |
| 4 | 140 | .4 | 4840 |
| 6 | 142 | .6 | 4730 |
| 8 | 144 | .8 | 4620 |
| 10 | 146 | 1.0 | 4520 |

The graphical routing to determine attenuation by storage is shown on p. 22

The attenuated outflow is 4760 cfs, with the peak water level 5.6 feet above the spillway crest. (2.2 feet above the left abutment, 1.4 feet above the right abutment, elevation 141.6 MSL).

The location of Millville Reservoir Dam is shown on p. 11.

Routing of Test Flood - Millville Reservoir Dam

$h = 5.6, Q = 4760 \text{ cfs}$

$Q_2 \text{ Vs Stage}$

Stage - Discharge Curve

p. 22

Discharge
(CFS)

HEAD ABOVE SPILLWAY (FEET)

5000

4000

3000

2000

1000

0

0

1

2

3

4

5

6

7

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS



INVENTORY OF DAMS IN THE UNITED STATES

| | |
|-------------------------|-------------|
| NAME | REPORT DATE |
| MILLVILLE RESERVOIR DAM | DAY MO YR |
| | |

| | |
|--------------------------------------|-----------------|
| NAME OF DAM | NAME OF PROJECT |
| MILLVILLE DAM | |
| NEAREST DOWNSTREAM CITY/TOWN/VILLAGE | DIST FROM DAM |
| | |

| | |
|----------------|------------|
| POPULATION | POPULATION |
| 1000 | |
| YEAR COMPLETED | YEAR |
| 1917 | |

| |
|-------------------------------|
| REMARKS |
| CONCRETE AND EARTH 25-100-100 |
| SPILLWAY 100-100-100 |
| POWER CAPACITY 100-100-100 |
| NAVIGATION LOCKS 100-100-100 |

| | |
|---------------|-----------------|
| INSPECTION BY | INSPECTION DATE |
| | DAY MO YR |
| INSPECTION BY | INSPECTION DATE |
| | DAY MO YR |

| |
|-------------------------------|
| REMARKS |
| CONCRETE AND EARTH 25-100-100 |
| SPILLWAY 100-100-100 |
| POWER CAPACITY 100-100-100 |
| NAVIGATION LOCKS 100-100-100 |

100-100-100