Response to

TECHNICAL ASSESSMENT DEFICIENCIES

Genwal Coal Company, Inc.

Crandall Canyon Property
PRO/015/032, Emery Country, Utah

TA RESPONSE

Genwal Coal Company, Inc.
Crandall Canyon Property
PRO/015/032, Emery County, Utah

UMC 783.14, .15, .25; UMC 817.59 Geology Description, Maps and Plans, Coal Recovery

We have indicated that the stratigraphy in the permit area and vicinity of the Crandall Canyon Mine consists of the Mesaverde group formations. Anyone who is reviewing this portion of our mine plan should be familiar with a description of these formations. If a further description is necessary, as applicant feels it might be after hearing the discussion on Genwal's "Technical Deficiency Summarization," please see:

> Central Utah Coal Fields: Sevier-Sanpete, Wasatch Plateau, Book Cliffs and Emery, Monograph Series No. 3, U.G.M.S., H. H. Doelling, 1972, page 68

or see:

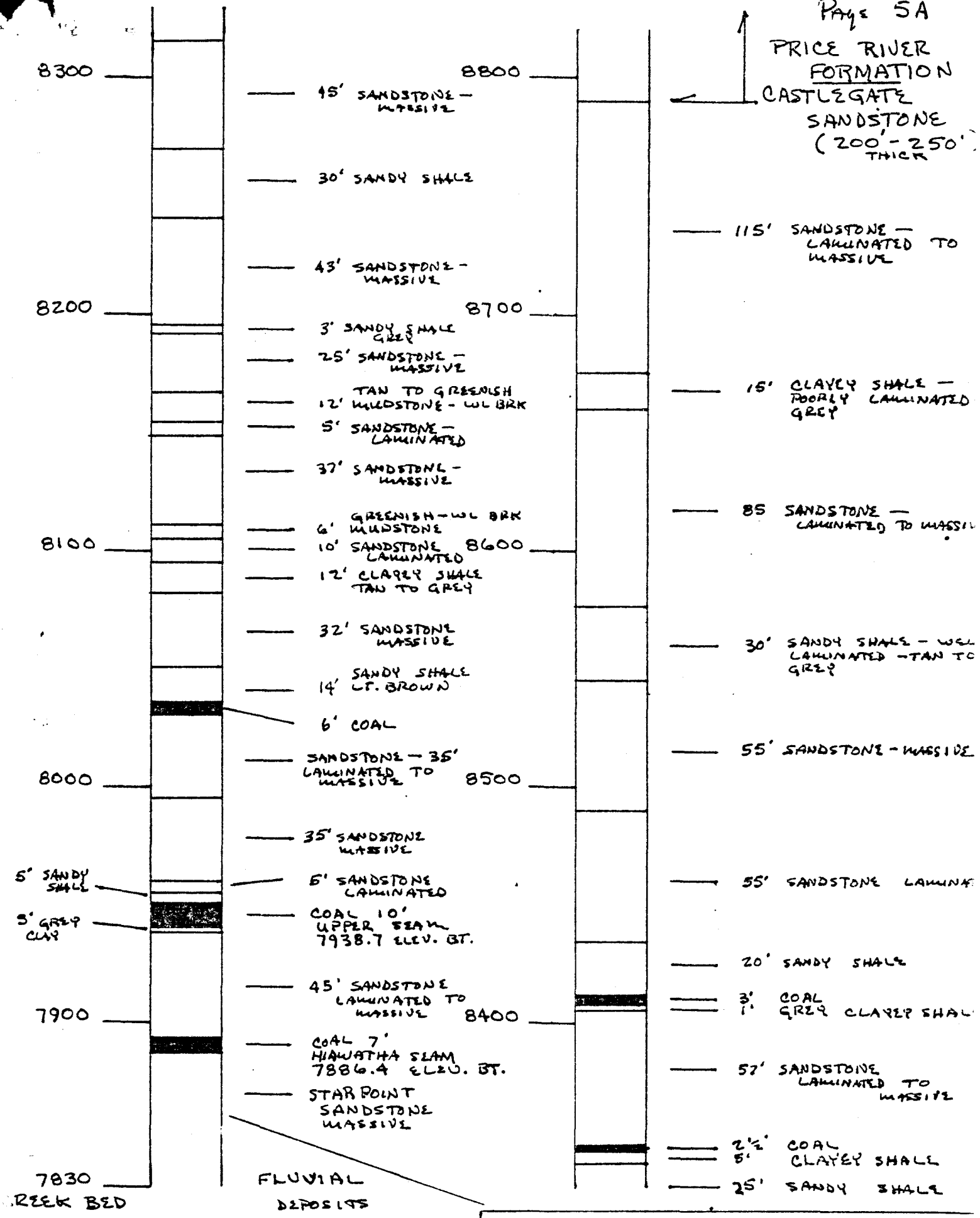
> Mining and Reclamation Plan, Huntington Canyon No. 4 Mine Permit Application submitted by Beaver Creek Coal Company--part 6.4.1 Stratigraphy, pages 6-4 through 6-10.

Applicant will include two lithologic, depth correlated sections to show thicknesses of interburden and coal from the Starpoint Sandstone to the surface. These geologic sections are attached to this document following this section. These cross sections should provide sufficient technical information to determine the nature, depth and thickness of the coal seams, rider seams, overburden and interburden strata for the permit area. Applicant feels this is also sufficient evidence to support the presence of the Blind Canyon Seam in Crandall Canyon. We will call it the Blind Canyon Seam at the request of D.O.G.M. to simplify further discussion. The same seam has been referred to as the "upper Hiawatha Seam," the "lower Bear Canyon Seam" at various other locations. We hope the cross sections will also satisfy the question concerning mineability of the "upper seam." U.S.G.S. is satisfied with the mineability of the "upper seam" from previously submitted documents. (Geologic cross-sections pages 5A and 5B)

Applicant feels that the cross sections submitted with this document will also satisfy the questions of coal recoverability, and roof and subsidence stability factors involving strata type and thickness.

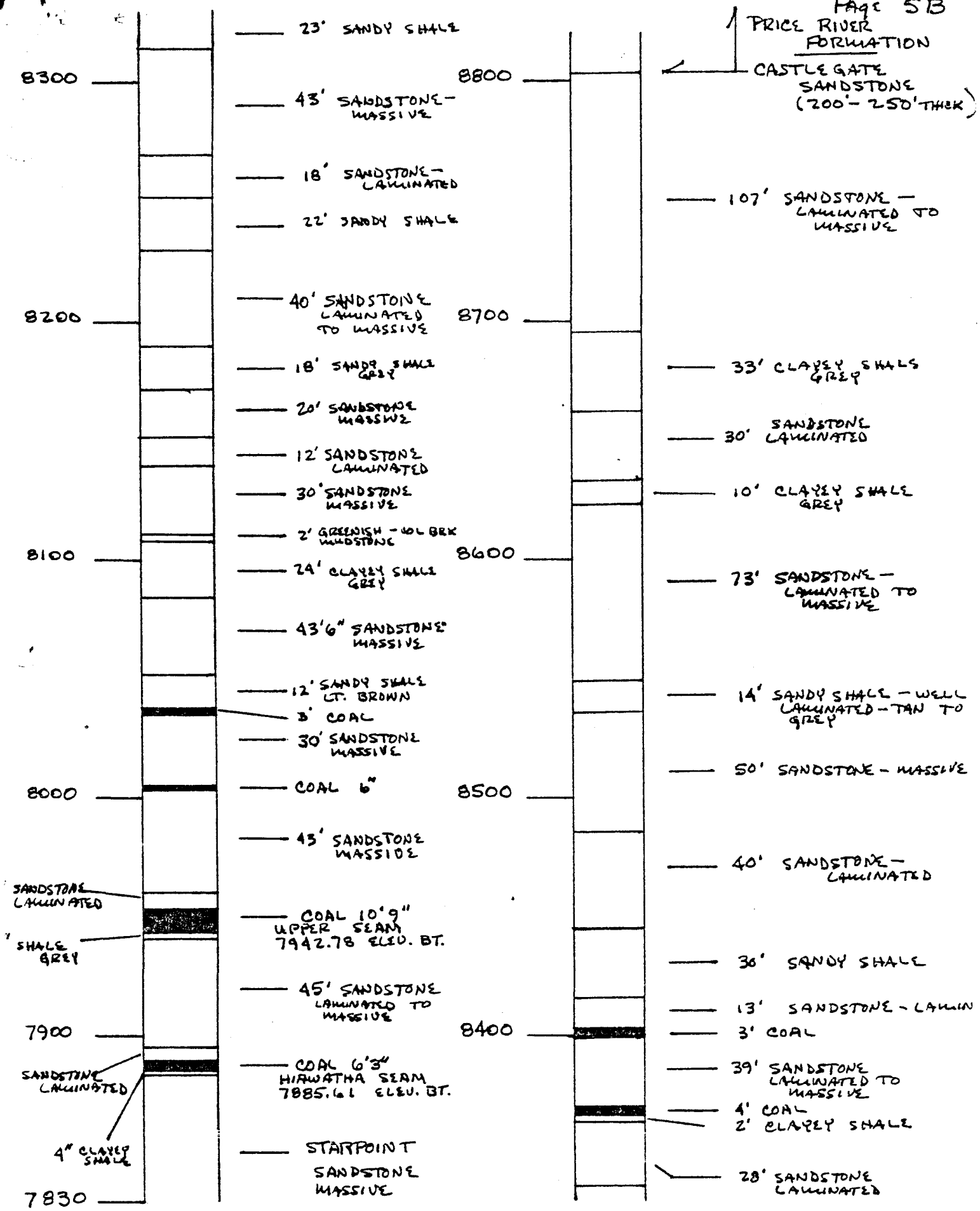
Applicant would now like to address the issue of the geology of the permit area as it would relate to the hydrology of the area. Field work, as stated in previously submitted documents, indicates there is no faulting that affects the geologic structure within the mine permit area, and the formations dip an average of 3° N, N.W. to the trough of the "Crandall Canyon Syncline." Applicant will also restate the fact that the old workings within the permit area are in the Hiawatha Seam, do not make any

* Location of geologic cross sections to permit area shown on drawing GCS-1 accompanying this document



SCALE 1" = 50'
SAME ELEVATIONS CHOSEN

CROSS SECTION A
GENLOAL — CRANDALL CANYON



SCALE 1" = 50'
SEAM ELEVATIONS SURVEYED

CROSS SECTION B
GENWAL — CRANDALL CANYON

water, and do not show evidence of ever having made water. The old workings are dry.

The aquiferous potential of the formations present in Crandall Canyon (Starpoint Sandstone, Blackhawk Formation, and the Castle Gate Sandstone) has been described in other documents submitted to D.O.G.M., and has been found technically adequate by D.O.G.M., and pertinent information as submitted is as follows:

(A) Mining and Reclamation Plan
Huntington Canyon #4 Mine
Beaver Creek Coal Company

Section 7--Hydrology

7.1.2 Existing Groundwater Resources

"Perched water conditions are common in the Blackhawk formation where the interbedded sandstone and shale units locally restrict ground water movement."

"Little data is available regarding the groundwater resources of the Wasatch Plateau."

"In the area of the No. 4 Mine, this water table is probably at about the same level as Huntington Creek, as this stream depends on ground water for its perennial flow."

7.1.1.1 Aquifers

"The principal units in the Huntington Canyon No. 4 Mine area that might be considered aquifers are the Star Point Sandstone and the Blackhawk Formation. The Castlegate Sandstone is generally a poor source for ground water because of its topographic position."

"Perched water zones in the Blackhawk Formation have been noted in drill holes throughout the area."

"It is likely that any faults that may exist are the controlling factor in determining the movement of ground water from one zone to another."

(B) Mining and Reclamation Plan
Deer Creek Mine
Emery Mining Company

Hydrology--Groundwater (783.15)
Volume 2, page 68

"These data have not identified any laterally continuous aquifers which are present throughout the area but have identified localized perched water tables in the North Horn Formation and Blackhawk Formation."

page 69:

"Perched water tables have not been identified in the Price River or Castlegate Sandstones. Both of these formations are relatively permeable, but lack sufficient recharge to make them water-bearing."

page 70:

"Studies conducted by the U.S.G.S. indicated that the Starpoint Sandstone is of low permeability, thus limiting its usefulness as a water producing aquifer."

page 71:

"Not only is the Blackhawk Formation inherently impermeable, but the faults and fractures in the Blackhawk apparently do not increase the water yielding characteristics of the formation by providing any significant secondary permeability. Confirmation of this exists along the numerous faults and fractures over the area. Very few springs are found within the Blackhawk along the extensive faults in the Wasatch Plateau."

"The coal seams in the Blackhawk Formation are impermeable."

"The Starpoint Sandstone immediately underlies the Hiawatha Coal Seam. This sandstone unit exhibits some characteristics of an aquifer but experiences little recharge. Most of the water recharge in the Starpoint is where it is intersected by the major canyons in the plateau. This fact plus the fact that the Starpoint is only slightly to moderately permeable allows only limited flow of ground water through this formation."

(C) Mining and Reclamation Plan
Wilberg Mine--Cottonwood Portals
Emery Mining Company.

Geohydrology Section, page 50:

"It is apparent that some 'perched' water is present in the sandstones that overlie the Hiawatha and Blind Canyon Seams. These lenticular continental sandstones are locally porous and permeable but usually do not interconnect, consequently water within these sandstones can be said to be 'perched' and cannot be referred to as aquifers."

"The third potential aquifer in the area is the Castlegate Sandstone. It is located 600' to 800' above the mine workings and consists of fairly coarse-grained massive sandstone that may locally be porous and permeable and may allow the passage of water."

Quantity of Groundwater, page 60:

"In the absence of detailed information about the hydrologic properties of the various stratigraphic units within East Mountain, it is believed that the primary porosity and permeability of the sandstone and of the coal seams is small, and that their ability to hold and conduct water depends largely upon secondary porosity and permeability created by the presence of joints and fractures, many of which are essentially vertical. No unit or units in the succession then can be considered aquifers in the sense that they are saturated with water and that they conduct water better than other units."

page 61:

"If there is a zone of complete saturation, the surface of which is a permanent water table, it is believed to be well below the deepest part of the coal beds under East Mountain."

Based on the above information concerning the formations and coal seams found in the Mesaverde group, and that the Mesaverde group formations in Crandall Canyon, as described by Doelling, and as described by applicant's field work, are as typical as found elsewhere, we believe the following information should be acceptable to D.O.G.M. as it relates to the hydrologic conditions of Genwal's permit area.

(1) We believe that a zone of saturation, (regional water table), if it exists, would be below the coal seams of the lower Blackhawk and probably at about the same level as Huntington Creek.

(2) The Starpoint Sandstone is only slightly to moderately permeable and allows only a very limited flow of ground water, which limits its usefulness as an aquifer.

Applicant does not anticipate that mining activities within the permit area will affect the Starpoint, if it is an aquifer, because the compressive and tensile strains associated with subsidence will be absorbed by the weaker, less massive strata of the Blackhawk formation above the coal seams.

(3) The Blackhawk Formation could contain "perched" aquifers in the lenticular sandstones interbedded with the shales. The shales of the Blackhawk are only slightly permeable and the sandstones usually do not interconnect; consequently, the water remains "perched." The shales of the Blackhawk are highly "bentonitic" and swell when wet; therefore, the faults and fractures in the Blackhawk would not appreciably increase the water-yielding characteristics of the formation by providing secondary permeability.

If "perched" water is encountered from the Blackhawk Formation, due to drilling or from the strains associated with subsidence, its vertical flow to deeper strata, if that is in fact the case, would be altered. It

is doubtful that this water flows to deeper strata anyway allowing to the impermeability of the coal in the lower Blackhawk and the Starpoint below the coal. Release of a "perched" aquifer, either by topographic conditions or strains of mining, would certainly not decrease the regional water table which is probably much lower in elevation from the Blackhawk. Some "perched" aquifers releasing water under topographic conditions as springs, may be affected. However, it is equally likely that springs and seeps could also result from the strains of subsidence.

(4) The third potential aquifer in the permit area is the Castlegate Sandstone, which may be porpous and coarse-grained, but is a poor source for ground water because it lacks rechargeability in the area, due to its topographic position.

(5) Effect of Mining Operations on Ground Water

An underground mining operation, like Genwal's proposed Crandall Canyon Mine, can be expected to have little, if any, effect on the ground water system of the region. The only potential aquifer, the Starpoint Sandstone, is below the level of mining, so destruction of the aquifer is unlikely. Some springs or seeps in the Blackhawk might be eliminated; others might be created. If water does enter the Castlegate, the impermeable nature of the Blackhawk would eliminate vertical passage to lower strata. Water that enters the Castlegate surfaces within the formation. Subsidence might create further fissuring and add to the recharge capabilities of the Castlegate.

(6) Monitoring

Applicant proposes to modify ground water monitoring program from previous submissions due to the availability of ground water information supplied.

Modifications:

(a) Spring in Crandall Creek will be monitored only if ground water occurs in the mine. Water in the mine could possibly deplete the spring if there is some interconnection, because the spring is down dip towards the syncline.

(b) Significant inflows of ground water intercepted during the course of mining will be monitored as per Part 783.15/817.52 of this document.

800.11, 805, 806 Bonding Requirements

Applicant proposes the type of bonding to be instituted for the mine life and reclamation monitoring period to be the entire performance bond for the entire permit term (i.e. 5 years plus a 10-year liability period) dependent upon reclamation success beginning at the time of the last augmented seeding, pursuant to UMC 805.13(b).

The form of performance bond that will be submitted to the regulatory authority pursuant to UMC 806.11(a) will be a surety bond (MR Form 5) as sent by D.O.G.M.

817.11 Signs and Markers

Applicant will install perimeter markers and topsoil markers. Perimeter and topsoil markers will conform to UMC 817.11 specifications as outlined below:

(1) Be posted, maintained and removed by the person who conducts the underground mining activities

(2) Be of uniform design throughout the activities that can be easily seen and read

(3) Be made of durable material

(4) Conform to local laws and regulations.

Topsoil and perimeter markers shall be maintained during all activities to which they pertain.

Perimeter markers will clearly mark the perimeter of all areas affected by surface operations or facilities before beginning mining activities.

Topsoil will be stockpiled and the stockpiles will be clearly marked.

817.13-.15 Casing and Sealing of Exposed Underground Openings

(a) Each mine entry which is temporarily inactive, but has a further projected useful service under the approved permit application, shall be protected by barricades or other covering devices, fenced, and posted with signs, to prevent access into the entry and to identify the hazardous nature of the opening. These devices shall be periodically inspected and maintained in good operating condition by the person who conducts the underground coal mining activities.

(b) Each exploration hole, other drill hole or borehole, shaft, well, and other exposed underground opening which has been identified in the approved permit application for use to return underground development waste, coal processing waste or water to underground workings, or to be used to monitor ground water conditions, shall be temporarily sealed until actual use.

817.11 Topsoil Removal

A small front-end loader on cat-tracks and a dozer (D-6 or equivalent) will be used to remove and load topsoil into tandem or off-road haul trucks. A qualified person, of supervisory capacity, will monitor, on site, the topsoil removal and stockpiling operation. It will be his responsibility to ensure that all the topsoil will be removed and stockpiled.

An additional 2,284 cubic yards of subsoil will be used to make up the topsoil shortage. Subsoil will be taken from the area indicated JDE on the soil survey map. The soil survey indicates there are approximately 6,806 cubic yards of subsoil available in the JDE area. The subsoil will

be removed in a 12-inch lift in the same manner as previously indicated for topsoil removal and under the same type of supervision.

817.24 Topsoil Redistribution

Topsoil will be redistributed with a small front-end loader on cat-tracks and a dozer (D-6 or equivalent). A qualified person, of supervisory capacity, will monitor, on site, the topsoil redistribution operation. This monitoring will ensure even distribution of the 0.75 feet of topsoil. To minimize compaction of the topsoil, after redistribution, the topsoil will be disked and/or harrowed on the contour.

817.25 Topsoil Nutrients and Amendments

As previously indicated, the topsoil stockpile will be sampled and analyzed prior to redistribution. Six auger sample locations, at evenly spaced intervals, will be taken from the stockpile. Two of the auger samples will be in the top 1/3 volume of the stockpile; two will be in the middle 1/3 volume of the stockpile; and two will be in the lower 1/3 volume of the stockpile.

An engineering sketch of the pile will be done prior to the sampling, so that the 1/3 volume determinations can be calculated and marked on the pile. Each auger sample will then be taken on the correct angle, to the approximate center of the pile. Angle and center of the pile are to be determined from the engineering sketch. Each sample will then be mixed and quartered to the size necessary for lab determination of necessary amendments. Results of the six samples, along with consultation from the regulatory authority, will determine the necessary amendments to the topsoil.

U817.42 Water Quality Standards and Effluent Limitations

Any unpredicted volume of ground water inflow which might occur during the mining operation will be pumped to a settling basin in an inactive underground area of the mine. The water will be treated for removal of oil and grease and will not be discharged from the mine until it meets effluent limitations as prescribed by the regulatory authority. There is adequate room for a settling basin in the area of the old works where we have proposed no active mining. The portion of the old works necessary for a settling basin could be ventilated adequately with return air, and be in compliance with MSHA regulations.

817.43 Diversions

(1) A map (scale 1 inch = 400 feet) has been prepared outlining the undisturbed area and disturbed area watershed boundaries. Please refer to sheet 019

(2) The 48-inch diameter culvert has been redesigned, and details for a concrete headwall at the inlet are illustrated on sheet 023
CALCULATIONS SD-1 thru SD-11 attached

817.46 Sedimentation Ponds

(1) A detailed evaluation of sediment yield, disturbed area runoff and necessary pond capacity has been performed. Our analysis indicates the sediment pond as proposed provides adequate volume to meet regulations. Re-design of the outlet was necessary to provide adequate detention time. Please refer to sheet 021 AND 022 for details.

Utilizing the Uniform Soil Loss Equation we estimate a 3-year sediment yield of approximately 478 tons or .30 acre-feet.
—CALCULATIONS P-1 THRU P-22 attached

(2) The outlet detailed on sheet 021 was chosen to eliminate the necessity of monitoring the pond during each storm event and manually releasing the flow after 24-hour detention as is necessary on some ponds at other mines in the area. The outlet structure will also serve as the sediment storage guage.

(3) Design details for erosion control at the inlet to the pond have been made and are included on sheet 022

(4) Recommendations of the State Engineer have been included in the design. Refer to sheets 020 and 021 AND 022.

783.15/817.52 Ground Water Information and Monitoring

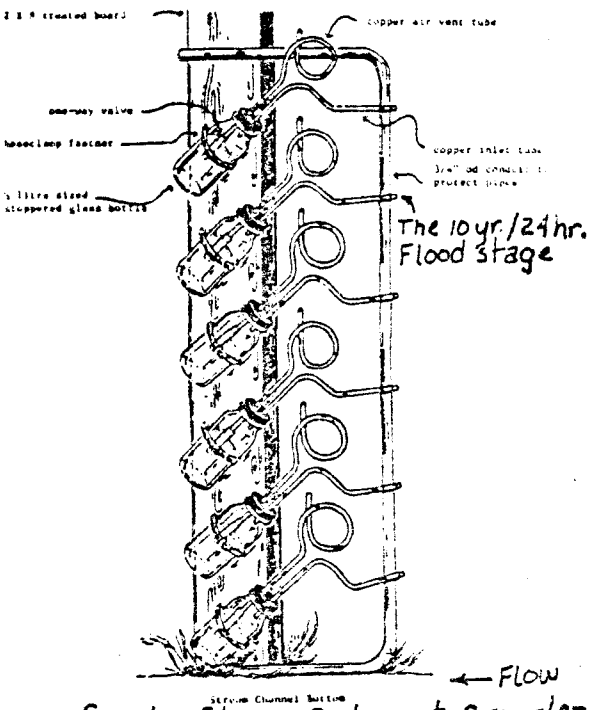
As indicated in the latest DOC response from Genwal, a monitoring program was proposed to establish the necessary baseline data for our Crandall Canyon Mine. As stated previously, this monitoring was proposed in lieu of the extrapolation of data from the Vaughn Hansen report, and this is because it was determined that there was not enough site specific data available on the ground water in Crandall Canyon that could have been extrapolated. See Part 783.14, .15, .25: UMC 817.59 of this document.

The geologic information requested under stipulation 817.59 will be submitted in this document under applicant's response to 817.59.

Significant inflows of ground water intercepted during the course of underground mining will be monitored and sampled bi-monthly for flow and quarterly for quality. Minimal parameters of location and flow rate, Ec, pH, TSS, TDS, total iron and manganese, will be determined in the quality analysis.

783.16/817.52 Surface Water Information and Monitoring

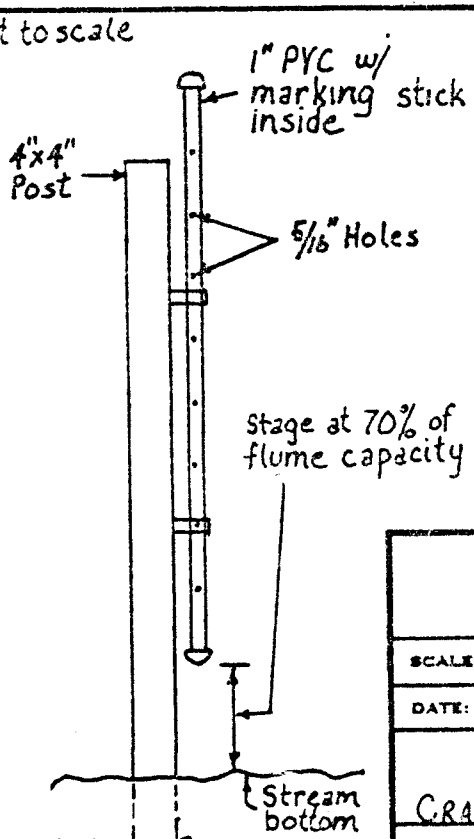
Accompanying this document is the detail design for the surface water monitoring stations to be installed on Crandall Creek. Both stations are of the same design. The design was secured by Watec Inc., of Denver, CO. Watec will also install the stations in the vicinity of the proposed location. After the stations are installed, they will be surveyed, and the exact locations will be plotted. Both stations will be located on private land. (SEE PAGES 8A AND 8B FOR DESIGN)



Single Stage Sediment Sampler
Side View

Not to scale

Not to scale



Crest Stage Gage
view looking downstream

DESIGN CRITERIA- Crandall Canyon (upper & lower sites)

Parshall Flume

Size: 3 ft. throat, 30 inch depth
Capacity: Approx. 42.7 cfs
Recorder: Stevens Type F, 30 day chart, battery powered
Base Material: Rip Rap
Wing Walls: Prefab galv. metal encased in concrete, anchored w/ 5 ft. T-posts
Flume Anchors: 5 ft. T-posts, connected w/ cable
Installation: Mainly by hand, w/ assistance of backhoe

Crest Stage Gage

Demensions: 5' x 1" x 1"
Material: PVC pipe on treated 4" x 4" post
Emplacement: Cemented in place
Base Height: Set at 70% of flume capacity

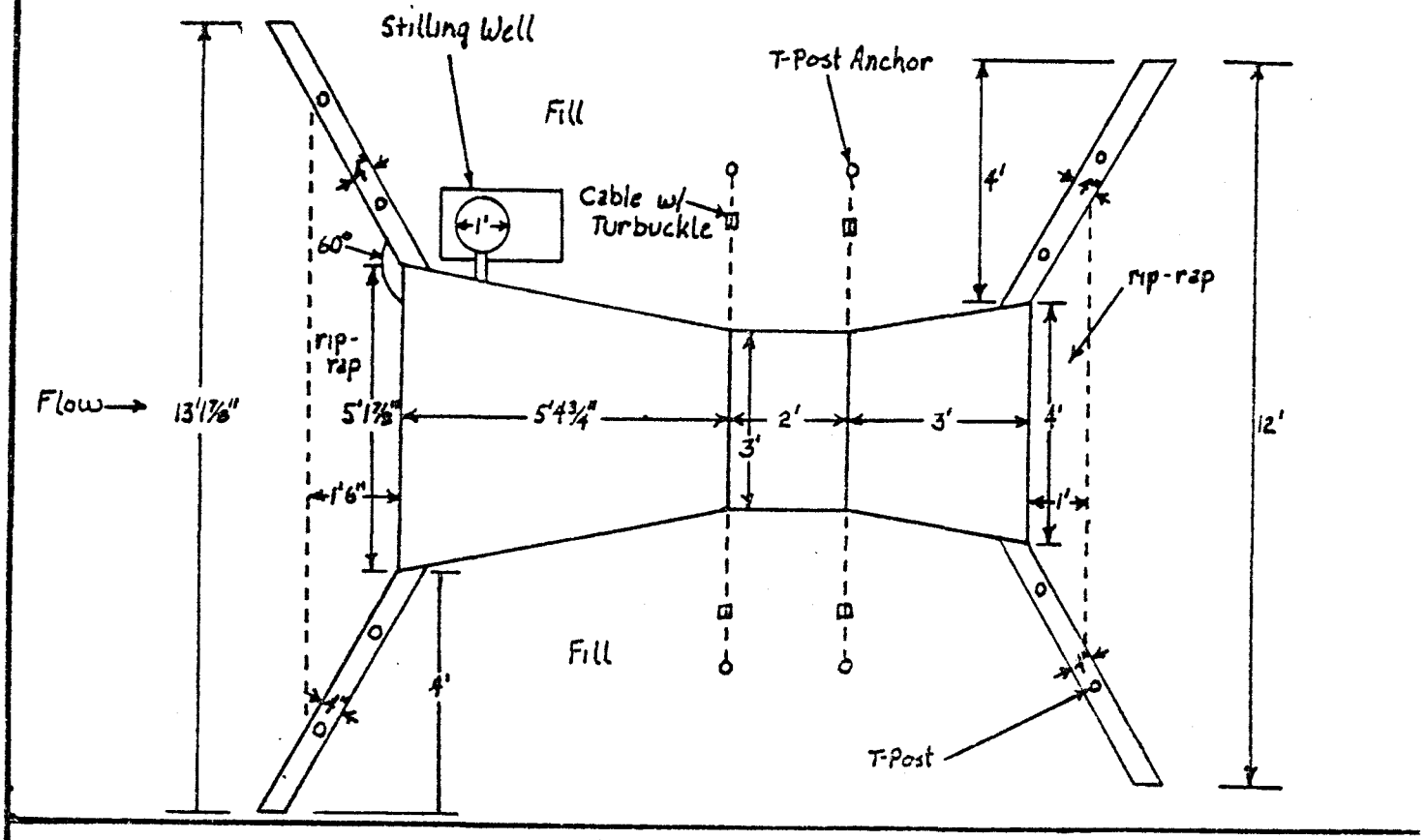
Single Stage Sediment Sampler

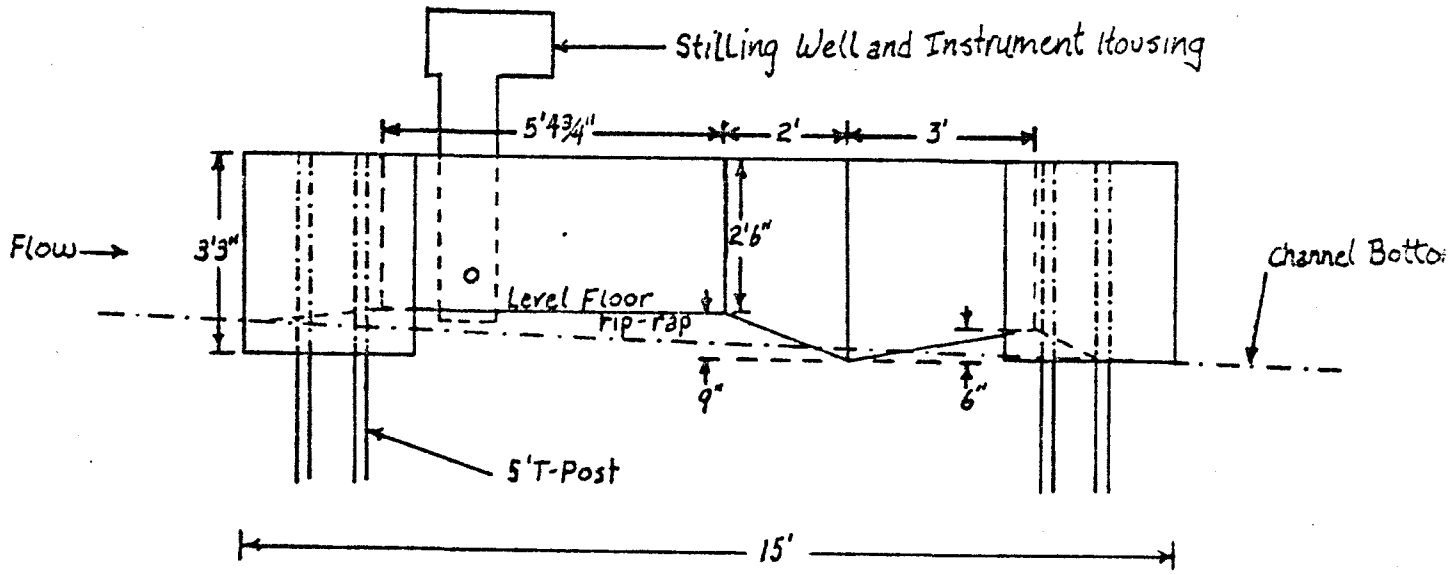
Consisting of 6 bottles- one set at 10yr./24hr. stage height; one above and four below.

Equipment

Hand tools
Backhoe

GENWAL COAL COMPANY		
SCALE: 1" = 3'	APPROVED BY: E.J. Phillips 1/23/82	DRAWN BY R.W.
DATE: 1-28-82		REVISED
CRANDALL CANYON (upper and lower sites) FLUME DESIGN		
WATEC, INC.		DRAWING NUMBER


Stilling Well
Fill
T-Post Anchor
Cable w/ Turbuckle
1'
60°
4'
rip-rap
rip-rap
Flow
13'1⅞"
5'1⅞"
5'4¾"
2'
3'
3'
4'
12'
1'6"
1'
Fill
4'
T-Post


Stilling Well and Instrument Housing
5'4¾"
2'
3'
Flow
3'3"
2'6"
Level Floor
rip-rap
Channel Botto
9"
6"
5' T-Post
15'

Applicant will implement the sampling of Crandall Creek as proposed in the permit application. Results of laboratory analysis will be forwarded to the Division as soon as they are received.

817.57 Stream Buffer Zones

Applicant proposes to use straw dams similar to the straw dam that was used during road construction that was done, under the USFS road use permit, during summer and fall of 1981. The straw dam had been installed by Genwal and approved by the USFS prior to construction activities. Throughout construction activities, the dam did an acceptable job of holding back sediment. The dam is still in place, and we wish to leave the dam in place until construction is completed. Applicant will install two more straw dams, of the same type, in Crandall Creek in the vicinity of stations 71+00 and 79+00. These dams consist of two rows of straw bales laid across the creek with the ends off-set and built high enough so that the water has to flow over the center portion of the dam. After construction is completed, sediment trapped behind the dams will be removed from the creek, and the dams will be removed.

A copy of this plan will be submitted to the State of Utah, Division of Public Health, Bureau of Water Pollution Control, with a request for a temporary variance to sediment control standards during applicant's construction phase.

The weekly sampling for water quality of Crandall Creek will be analyzed for the following parameters: TDS, TSS, pH, Ec, and water temperature. The two sites for sampling will be as follows: above the construction site approximately 300 feet upstream from the quarter corner designated as station 2A on the construction drawings. The other site will be below the construction disturbance at station 72+50. Turbidity measurements will also be taken daily at both sampling locations. Turbidity will be indicated in NTUs.

817.59 Coal Recovery

The numerical itemization of planned coal development cannot be correlated with a yearly calendar sequence as requested. However, pages three and four of the "Subsidence Monitoring Plan," which itemized the sequence of coal development, were revised to show a monthly correlation of development from the first through the 60th month of our permit term. Subsidence monitoring will begin during our 10th month of operation. The revised pages three and four of "Subsidence Monitoring Plan" follow this 817.59 section of this document.

The mining plans for the Upper and Lower Hiawatha Coal Seams are illustrated in Drawings 4047-1 and 4047-2 respectively. The seams will be developed in the following sequence:

	LOWER SEAM		UPPER SEAM
1.	Portal area excavated--1 month		----------
2.	Actual portals established--1 month	1.	Portal area excavated--1 mo.
3.	Permanent fan installed for ventilation--1 month	2.	Actual portals established--1 month
4.	North Mains started--37 month	3.	Permanent fan installed for ventilation--1 month
5.	North Mains completed to intersection of West Mains--39 month	4.	North Mains started--1 month
6.	West Mains started--39 month	5.	North Mains completed to intersection of West Mains--3 month
7.	West Mains completed--42 month	6.	West Mains started--3 month
8.	Development of Panel "B" started--42 month	7.	West Mains completed--5 month
9.	Development of Panel "B" completed--45 month	8.	Development of Panel "A" started--5 month
10.	Development of Panel "A" started--46 month	9.	Development of Panel "A" completed--10 month
11.	Development of Panel "A" completed--48 month	10.	Second mining started in Panel "A"--10 month
12.	Second mining started in Panel "A"--48 month	11.	Second mining completed in Panel "A"--15 month
13.	Second mining completed in Panel "A"--51 month	12.	Panel "A" sealed--15 month
14.	Panel "A" sealed--51 month	13.	Development of Panel "B" started--15 month
	----------	14.	Development of Panel "B" completed--19 month
	----------	15.	Second mining started in Panel "B"--19 month
15.	Second mining started in Panel "B"--51 month	16.	Second mining completed in Panel "B"--23 month

16. Second mining completed in Panel "B"--54 month

17. Panel "B" sealed--54 month

18. Second mining of West Mains started--54 month

19. Second mining of barrier pillars for West Mains started--54 month

20. Second mining of West Mains & barrier pillars completed to Panel "C" intake--56 month

21. Development for Panel "C" started--56 month

22. Development for Panel "C" completed--57 month

23. Second mining for Panel "C" started--57 month

24. Second mining for Panel "C"--58 month

25. Panel "C" sealed--58 month

26. Second mining for West Mains continued--58 month

27. Second mining for barrier pillars for West Mains continued--58 month

28. Second mining for North Mains & barrier pillars started & completed--60 month

29. Portal sealed--60 month

17. Panel "B" sealed--23 month

18. Second mining of West Mains started--23 month

19. Second mining of barrier pillars for West Mains started--23 month

20. Second mining of West Mains & barrier pillars completed to Panel "C" intake--27 month

21. Development for Panel "C" started--27 month

22. Development for Panel "C" completed--30 month

23. Second mining for Panel "C" started--30 month

24. Second mining for Panel "C" completed--34 month

25. Panel "C" sealed--34 month

26. Second mining for West Mains continued--34 month

27. Second mining for barrier pillars for West Mains continued--34 month

28. Second mining for North Mains & barrier pillars started & completed--37 month

29. Portal sealed--37 month

817.89 Disposal of Noncoal Waste

An area for disposal of non-coal waste has been identified as illustrated on sheet 016

All waste oil and grease will be stored in metal containers at the location designated "Waste Storage" on drawing No. 016

All waste items contaminated with oil and grease will also be stored at the same designated location.

All waste items stored at the "WASTE STORAGE" location will be removed from the mine site and disposed of by American Kinfolk, Inc., of Huntington, Utah, as per the following letter. (Letter included with document.) AS PAGE 12A

Also, a berm will be installed around the diesel storage tank which will have the capability of retaining the leakage or spillage of a full tank of diesel fuel. (SEE DRAWING NO. 016)

817.99 Slides and Other Damage

If a slide should occur within the permit area, applicant will notify the regulatory agency and comply with any remedial measures required by the regulatory agency.

817.101-.106 Backfilling and Grading

Genwal concurs that the regulatory agency will determine what is "practical" for postmining topography. Applicant will not submit any postmining cross sections or topographic maps other than what has already been submitted.

817.121-.126 Subsidence Control

Applicant commits to implementing the proposed subsidence control plan, and applicant hereby incorporates same into applicant's proposed Mining and Reclamation Plan.

817.131 Cessation of Operations: Temporary

Applicant will implement the temporary cessation regulations as follows:

(a) Each person who conducts underground coal mining activities shall effectively support and maintain all surface access openings to underground operations, and secure surface facilities in areas in which there are no current operations, but operations are to be resumed under an approved permit. Temporary abandonment shall not relieve a person of his or her obligation to comply with any provisions of the approved permit.

(b) Before temporary cessation of mining and reclamation operations for a period of thirty days or more, or as soon as it is known that a temporary cessation will extend beyond 30 days, each person who

American Kinfolk, Inc.
P. O. BOX 780
HUNTINGTON, UTAH 84528

Dec. 21, 1981

Gen Wal Coal Co. Inc.
P.O. Box 1201
Huntington, Utah 84528

Attn; Mr. Bill Wollen

Dear Sir;

As per our recent telephone conversation with you in regard to our company handling the trash removal from your mine, we are herewith submitting our proposal to you for this service.

We will send our truck to your mine and haul away and dispose of whatever waste material (solid) that is generated by or from your mine. The loading of this material will be handled by your loader operator and we will send our truck to your mine as often as necessary to prevent any backlog or build-up of trash.

Our charge to you for this service will be $75.00 per load. A load being 16 cubic yards of material which our ten wheel dump truck will haul. Should we use any different or larger truck we will adjust the per load charges accordingly. This will be our only charge for this service with one possible exception; that being an additional charge for "down time" should our driver have to wait for an abnormal length of time to get loaded. We will, however, contact you and discuss the matter before tacking on any additional charges.

All material that we haul from your mine will be disposed of in our licensed sanitary land fill located north of Huntington, Utah and will become the property and responsibility of our company. Should you send something out in the trash that you need to have back, please call us and we will make every effort to get it back for you.

We trust that this proposal will meet with your satisfaction and if the matter needs any furthur discussion or adjustment please feel free to contact me at any time. I can be reached at 687-9549, or 687-2231, or 687-2671. Thank you for your consideration and,

Best Regards,

conducts underground mining activities shall submit to the Division a notice of intention to cease or abandon operations. This notice shall include a statement of the exact number of surface acres and the horizontal and vertical extent of sub-surface strata which have been in the permit area prior to cessation or abandonment, the extent and kind of reclamation of surface area which will have been accomplished, and identification of the backfilling, regrading, revegetation, environmental monitoring, underground opening closures and water treatment activities that will continue during the temporary cessation.

817.132 Cessation of Operations: Permanent

All surface equipment, as well as structures, including all concrete foundations, will be removed by the applicant after the permanent cessation of operations. At the time that the mine closure plan is submitted to the USGS, a copy will be forwarded to the Division for concurrence and approval and for addition to the mine plan on file. A copy will also be placed at the Emery County Recorder's Office.

817.150-.176 Roads

Cut slopes have been modified to comply with recommendations offered in geotechnical investigations performed by R & M Consultants and Delta. Please refer to the following sheet numbers for design details of the described deficiency:

Cut Slopes	Sheet No. 017
Portal Access Road Cross Sections	Sheet No. 018
Cut/Fill Access Road Profiles	Sheet No. 018
Access Road Cross Sections	Sheet No. 018

Exception is taken to the last two sentences of paragraph 1, 817.150-.176. These sentences infer 1:1 excavation slopes are unsafe and not acceptable in all materials. We concur that 1:1 excavation slopes are not suitable in the superficial topsoil deposits and have included slope rounding of these slopes at 1.5:1 in our details. However, reference is made to the report by R & M Consultants and the natural topography. If the factor of safety of .72 were correct, most areas of the existing canyon would already have failed as the natural slope approaches 1:1 in the entire canyon. Any excavation slope greater than 1:1 (with exception of slope rounding) would be unrealistic and impose unnecessary impact far beyond the current limits. In many instances, a 1.5:1 excavation slope will not catch at all. We urge on-site inspection of conditions and existing roads in the local area.

817.181 Support Facilities

See response to 817.89 "Disposal of Non-Coal Waste," this document. A retention berm has been provided for the fuel storage tank. Please refer to sheet 016

Boyle Engineering Corporation STORM DRAIN PIPE

BY JW DATE 5-20-82 SUBJECT CRANDALL CYN. MING SHEET NO. 1 OF 9
CHKD. BY RS DATE 5-21-82 ENERGY DISSIPATOR JOB NO. BM-G01-001-00

• ENERGY DISSIPATOR FOR 30" PIPE - REDUCE VELOCITY BEFORE OUTLET

30" PIPE @ S_1 = 25.23% & S_2 = 2.0%
Q = 68 cfs

HEC BACKWATER SHOWS NO JUMP OCCURS. OUTLET
V = 29 FPS ±

DESIRE TO REDUCE OUTLET V < 15 FPS SO
RIPRAP EROSION PROTECTION CAN BE USED
(TABLE 15.4, OSM COMPLIANCE MANUAL)

REF. U.S. DOT. "HYDRAULIC DESIGN OF ENERGY
DISSIPATORS FOR CULVERTS & CHANNELS" HYDRAULIC
ENGRG. CIRCULAR No. 14, DEC. 75

VII-B-7 "TUMBLING FLOW IN CIRCULAR CULVERTS"

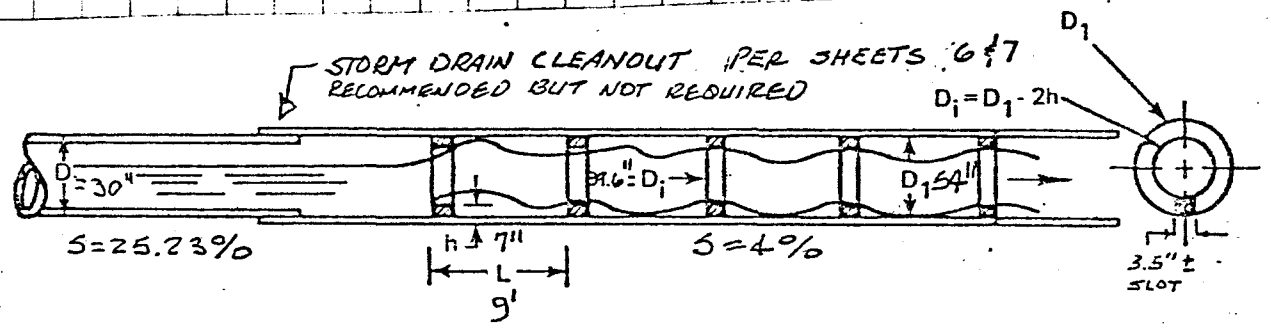


FIGURE VII-B-4. DEFINITION SKETCH FOR TUMBLING FLOW IN CIRCULAR CULVERTS

GIVEN: 30 INCH DIAM CONCRETE PIPE, L = 390 FT
n = 0.012 S_1 = 0.2523 (L = 340')
S_2 = 0.02 (L = 50')

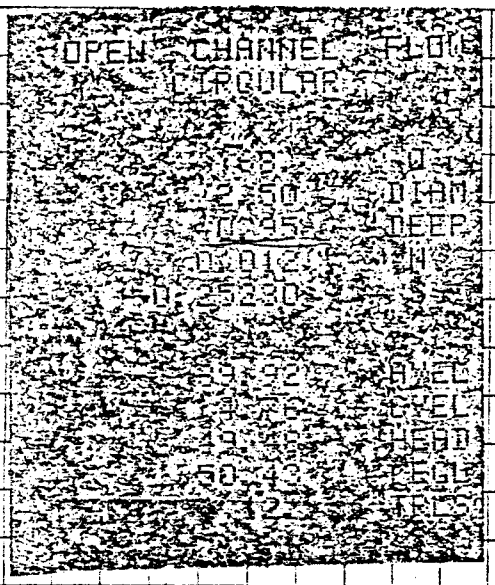
V_0 = 39.9 FPS (SEE CALCULATOR PRINTOUT NEXT PAGE)

INLET CONTROL

Boyle Engineering Corporation

BY _____ DATE _____ SUBJECT ENERGY DISSIPATOR SHEET NO. 2 OF 9

CHKD. BY _____ DATE _____ JOB NO. _____



PROCEDURE:

1) INLET CONTROL GOVERNS

2) DETERMINE DIAMETER, D_1, OF ROUGHENED SECTION

$$1.6(Q^2/g)^{0.2} < D_1 < 1.9(Q^2/g)^{0.2}$$

$$4.32' < D_1 < 5.13' \quad \text{USE } D_1 = \underline{4.5'}$$

3) COMPUTE h & L:

$$h/D_1 = 0.125 \pm 0.25 \rightarrow 0.42' < h < 0.70', \text{ USE } \underline{0.58'} \ (7")$$

$$L/D_1 = 2.0 \pm 0.2 \rightarrow 7.2' < L < 10.8', \text{ USE } \underline{\underline{9'}}$$

4) COMPUTE D_i:

$$D_i = D_1 - 2h = 4.5 - (2 \times 0.58) = \underline{\underline{3.3'}}$$

Boyle Engineering Corporation

BY _____ DATE _____ SUBJECT ENERGY DISSIPATOR SHEET NO. 3 OF 9

CHKD. BY _____ DATE _____ JOB NO. _____

5) DETERMINE CRITICAL DEPTH (Y_c) FROM FIG III-4 FOR $Q = 68$ CFS & $D_1 = 3.3'$

$$Y_c = 2.7'$$

6) $Y_c / D_i = \frac{2.7}{3.3} = 0.82$

7) DETERMINE A_c FROM TABLE III-2 USING Y_c/D_i FOR d/D

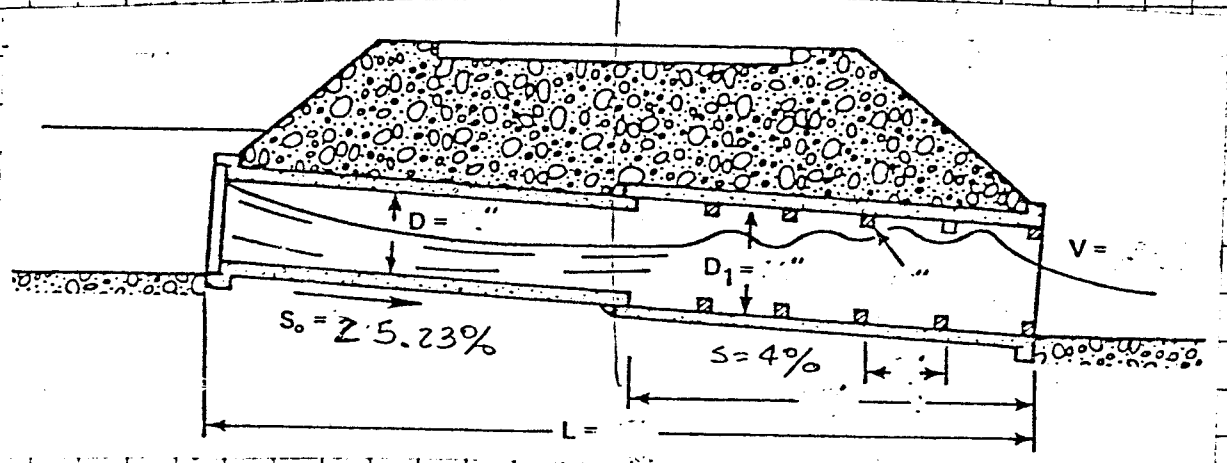
$$\frac{A}{D^2} = \frac{A_c}{D_i^2} = 0.6893 \Longrightarrow A_c = 0.6893(D_i)^2$$
$$= 0.6893(3.3)^2$$
$$= 7.51 \text{ FT}^2$$

8) COMPUTE OUTLET VELOCITY

$$V_o = Q/A_c = 68/7.51 = \underline{\underline{9 \text{ FPS}}}$$

9) PUT SLOT (WIDTH = $0.5h = 3.5''$)

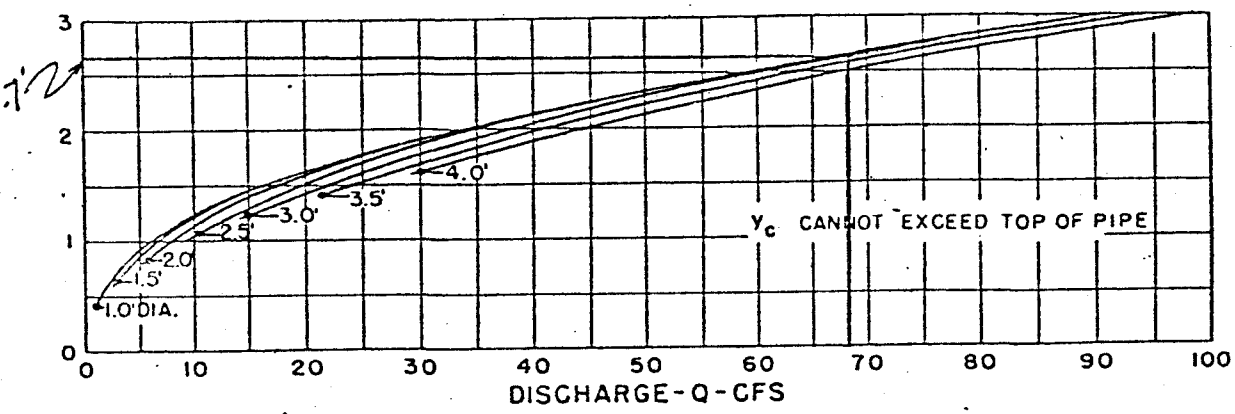
GRADE BREAK @ STA 11+30

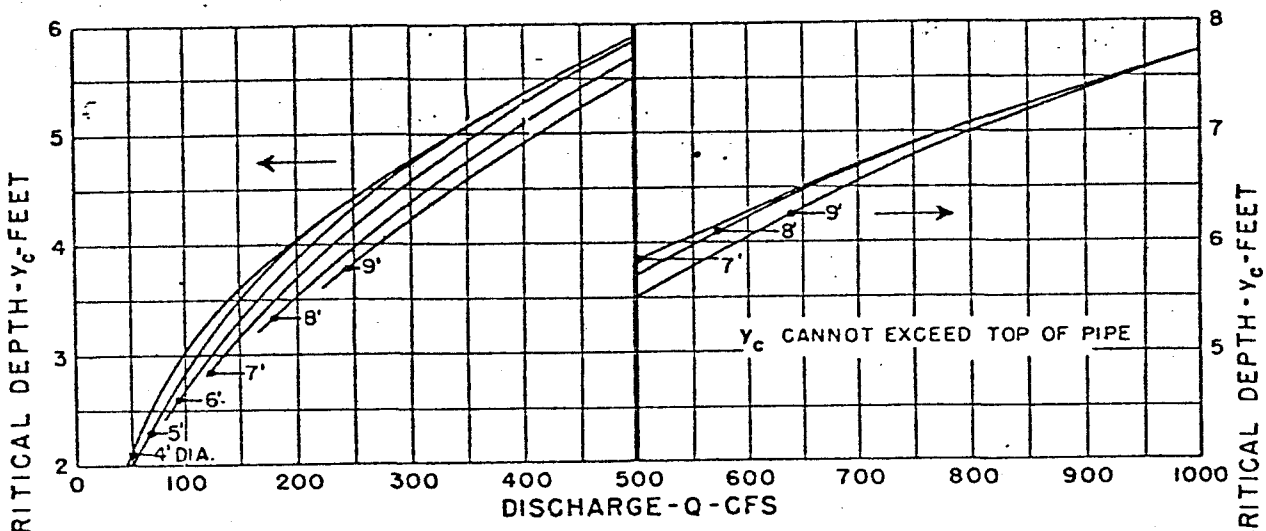


NOTE: WE RECOMMEND A CLEANOUT AT GRADE BREAK (See Sheet 6 & 7) AND A TRASH RACK AT INLET.

SD-4

4 OF 9





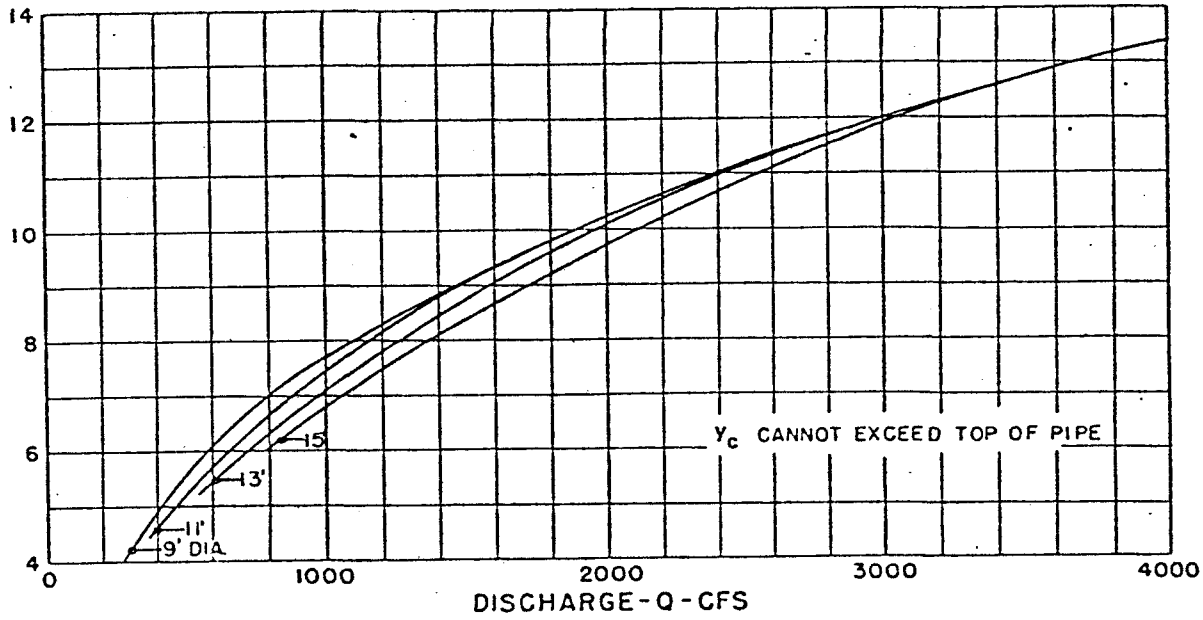


FIGURE III-4

CRITICAL DEPTH
CIRCULAR PIPE

SD-5
5 of 9

Table III-2.—*Uniform flow in circular sections flowing partly full.* From Reference III-3.

d = depth of flow
D = diameter of pipe
A = area of flow
R = hydraulic radius
Q = discharge in cubic feet per second by Manning's formula
n = Manning's coefficient
S = slope of the channel bottom and of the water surface

$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{R}{D}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qn}{d^{8/3}S^{1/2}}$	$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{R}{D}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qn}{d^{8/3}S^{1/2}}$
0.01	0.0013	0.0066	0.00007	15.04	0.51	0.4027	0.2531	0.239	1.442
0.02	0.0037	0.0132	0.00031	10.57	0.52	0.4127	0.2562	0.247	1.415
0.03	0.0069	0.0197	0.00074	8.56	0.53	0.4227	0.2592	0.255	1.388
0.04	0.0105	0.0262	0.00138	7.38	0.54	0.4327	0.2621	0.263	1.362
0.05	0.0147	0.0325	0.00222	6.55	0.55	0.4426	0.2649	0.271	1.336
0.06	0.0192	0.0389	0.00328	5.95	0.56	0.4526	0.2676	0.279	1.311
0.07	0.0242	0.0451	0.00455	5.47	0.57	0.4625	0.2703	0.287	1.286
0.08	0.0294	0.0513	0.00604	5.09	0.58	0.4724	0.2728	0.295	1.262
0.09	0.0350	0.0575	0.00775	4.76	0.59	0.4822	0.2753	0.303	1.238
0.10	0.0409	0.0635	0.00967	4.49	0.60	0.4920	0.2776	0.311	1.215
0.11	0.0470	0.0695	0.01181	4.25	0.61	0.5018	0.2799	0.319	1.192
0.12	0.0534	0.0755	0.01417	4.04	0.62	0.5115	0.2821	0.327	1.170
0.13	0.0600	0.0813	0.01674	3.86	0.63	0.5212	0.2842	0.335	1.148
0.14	0.0668	0.0871	0.01952	3.69	0.64	0.5308	0.2862	0.343	1.126
0.15	0.0739	0.0929	0.0225	3.54	0.65	0.5404	0.2882	0.350	1.105
0.16	0.0811	0.0985	0.0257	3.41	0.66	0.5499	0.2900	0.358	1.084
0.17	0.0885	0.1042	0.0291	3.28	0.67	0.5594	0.2917	0.366	1.064
0.18	0.0961	0.1097	0.0327	3.17	0.68	0.5687	0.2933	0.373	1.044
0.19	0.1039	0.1152	0.0365	3.06	0.69	0.5780	0.2948	0.380	1.024
0.20	0.1118	0.1206	0.0406	2.96	0.70	0.5872	0.2962	0.388	1.004
0.21	0.1199	0.1259	0.0448	2.87	0.71	0.5964	0.2975	0.395	0.985
0.22	0.1281	0.1312	0.0492	2.79	0.72	0.6054	0.2987	0.402	0.965
0.23	0.1365	0.1364	0.0537	2.71	0.73	0.6143	0.2998	0.409	0.947
0.24	0.1449	0.1416	0.0585	2.63	0.74	0.6231	0.3008	0.416	0.928
0.25	0.1535	0.1466	0.0634	2.56	0.75	0.6319	0.3017	0.422	0.910
0.26	0.1623	0.1516	0.0686	2.49	0.76	0.6405	0.3024	0.429	0.891
0.27	0.1711	0.1566	0.0739	2.42	0.77	0.6489	0.3031	0.435	0.873
0.28	0.1800	0.1614	0.0793	2.36	0.78	0.6573	0.3036	0.441	0.856
0.29	0.1890	0.1662	0.0849	2.30	0.79	0.6655	0.3039	0.447	0.838
0.30	0.1982	0.1709	0.0907	2.25	0.80	0.6736	0.3042	0.453	0.821
0.31	0.2074	0.1756	0.0966	2.20	0.81	0.6815	0.3043	0.458	0.804
0.32	0.2167	0.1802	0.1027	2.14	0.82	0.6893	0.3043	0.463	0.787
0.33	0.2260	0.1847	0.1089	2.09	0.83	0.6969	0.3041	0.468	0.770
0.34	0.2355	0.1891	0.1153	2.05	0.84	0.7043	0.3038	0.473	0.753
0.35	0.2450	0.1935	0.1218	2.00	0.85	0.7115	0.3033	0.477	0.736
0.36	0.2546	0.1978	0.1284	1.958	0.86	0.7186	0.3026	0.481	0.720
0.37	0.2642	0.2020	0.1351	1.915	0.87	0.7254	0.3018	0.485	0.703
0.38	0.2739	0.2062	0.1420	1.875	0.88	0.7320	0.3007	0.488	0.687
0.39	0.2836	0.2102	0.1490	1.835	0.89	0.7384	0.2995	0.491	0.670
0.40	0.2934	0.2142	0.1561	1.797	0.90	0.7445	0.2980	0.494	0.654
0.41	0.3032	0.2182	0.1633	1.760	0.91	0.7504	0.2963	0.496	0.637
0.42	0.3130	0.2220	0.1705	1.724	0.92	0.7560	0.2944	0.497	0.621
0.43	0.3229	0.2258	0.1779	1.689	0.93	0.7612	0.2921	0.498	0.604
0.44	0.3328	0.2295	0.1854	1.655	0.94	0.7662	0.2895	0.498	0.588
0.45	0.3428	0.2331	0.1929	1.622	0.95	0.7707	0.2865	0.498	0.571
0.46	0.3527	0.2366	0.201	1.590	0.96	0.7749	0.2829	0.496	0.553
0.47	0.3627	0.2401	0.208	1.559	0.97	0.7785	0.2787	0.494	0.535
0.48	0.3727	0.2435	0.216	1.530	0.98	0.7817	0.2735	0.489	0.517
0.49	0.3827	0.2468	0.224	1.500	0.99	0.7841	0.2666	0.483	0.496
0.50	0.3927	0.2500	0.232	1.471	1.00	0.7854	0.2500	0.463	0.463

ce III-3.

z = 3

10.4
11.3
12.2
13.2
14.2

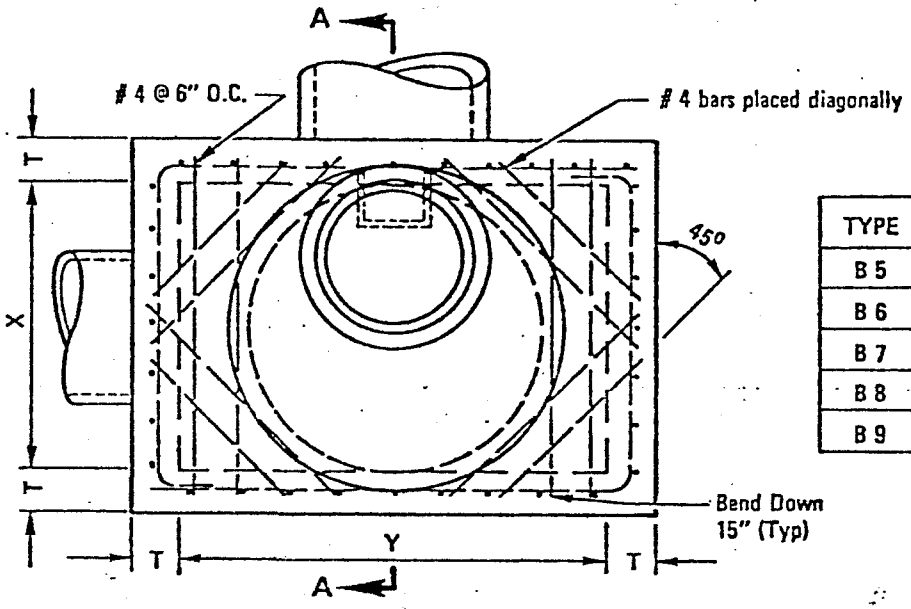
15.2
16.3
17.4
18.7
19.9

21.1
23.9
26.8
30.0
33.4

37.0
40.8
44.8
49.1
53.7

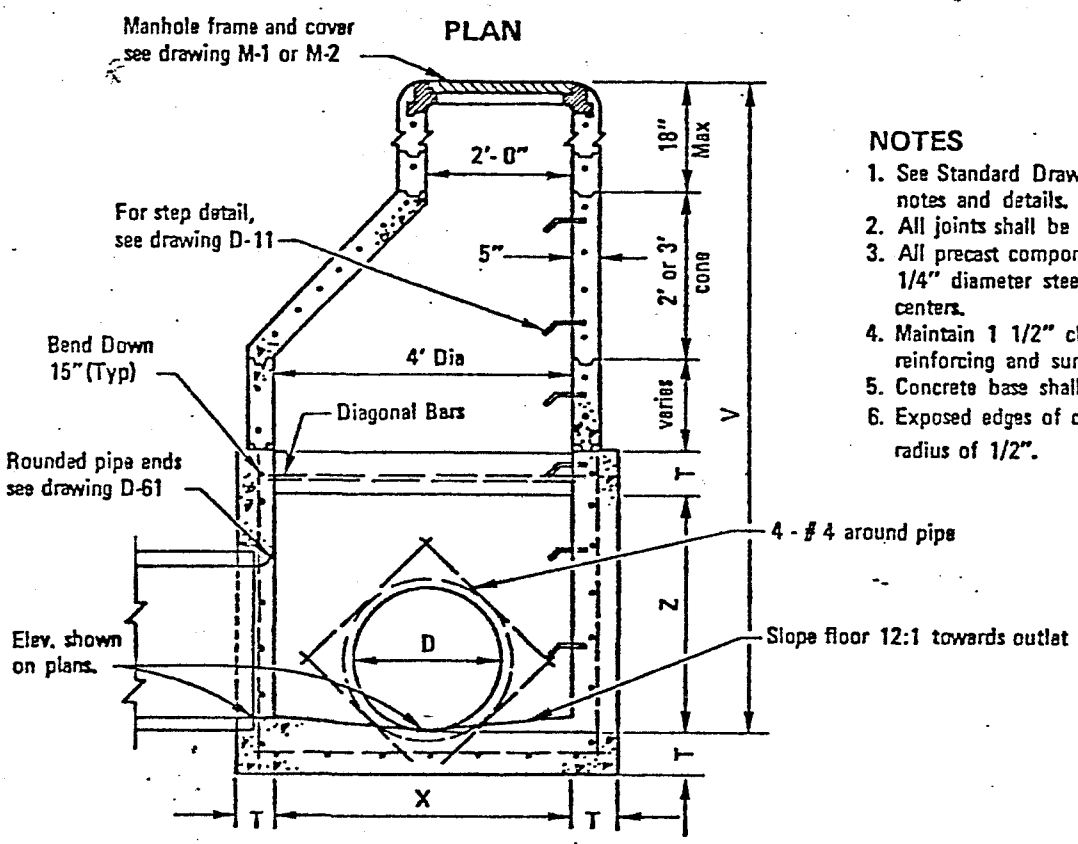
58.4
68.9
80.2
92.8
107

122
164
216



PLAN

TYPE	PIPE DIA	X	Y	Z
B 5	up to 51"	4'	5'	5'
B 6	54" to 60"	4'	6'	6'
B 7	63" to 69"	4'	7'	7'
B 8	72" to 81"	4'	8'	8'
B 9	84" to 90"	4'	9'	9'



SECTION A–A

NOTES

1. See Standard Drawing D-11 for additional notes and details.
2. All joints shall be set in Class C mortar.
3. All precast components shall be reinforced with 1/4" diameter steel wound spirally on 4" centers.
4. Maintain 1 1/2" clear spacing between reinforcing and surface.
5. Concrete base shall be 564 - C - 3000.
6. Exposed edges of concrete shall be rounded with a radius of 1/2".

LEGEND ON PLANS

RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

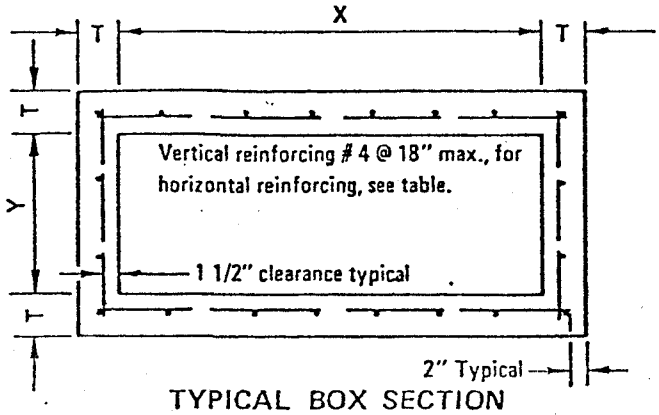
Coordinator R.C.E. 19807 — Dec. 1975 Date

DRAWING NUMBER D-10

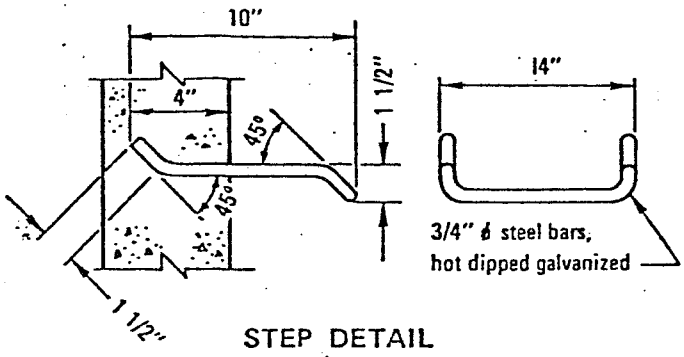
SAN DIEGO REGIONAL STANDARD DRAWING

STORM DRAIN CLEANOUT - TYPE B

Revision	By	Approved	Date



TYPICAL BOX SECTION



STEP DETAIL

BOX SECTION REINFORCEMENT			
MAXIMUM SPAN X or Y	DEPTH V	THICK-NESS T	HOR. & FLR. REINF.
3' - 0" to 4' - 0"	4' - 0"	6"	# 4 @ 18"
4' - 1" to 7' - 0"		6"	# 4 @ 12"
7' - 1" to 8' - 0"		6"	# 4 @ 8"
3' - 0" to 4' - 0"	4' - 1" to 8' - 0"	6"	# 4 @ 18"
4' - 1" to 5' - 0"		6"	# 4 @ 12"
5' - 1" to 6' - 0"		6"	# 4 @ 8"
6' - 1" to 8' - 0"		6"	# 4 @ 6"
3' - 0" to 4' - 0"	8' - 1" to 12' - 0"	6"	# 4 @ 15"
4' - 1" to 5' - 0"		8"	# 4 @ 12"
5' - 1" to 6' - 0"		8"	# 4 @ 8"
6' - 1" to 8' - 0"		8"	# 4 @ 6"
3' - 0" to 4' - 0"	12' - 1" to 16' - 0"	6"	# 4 @ 12"
4' - 1" to 5' - 0"		8"	# 4 @ 12"
5' - 1" to 6' - 0"		8"	# 4 @ 8"
6' - 1" to 7' - 0"		8"	# 4 @ 6"
7' - 1" to 8' - 0"		8"	# 5 @ 8"
3' - 0" to 4' - 0"	16' - 1" to 20' - 0"	8"	# 4 @ 12"
4' - 1" to 5' - 0"		10"	# 4 @ 12"
5' - 1" to 6' - 0"		10"	# 4 @ 8"
6' - 1" to 7' - 0"		10"	# 4 @ 6"
7' - 1" to 8' - 0"		10"	# 5 @ 8"
3' - 0" to 4' - 0"	20' - 1" to 24' - 0"	8"	# 4 @ 12"
4' - 1" to 5' - 0"		10"	# 4 @ 12"
5' - 1" to 6' - 0"		10"	# 4 @ 8"
6' - 1" to 7' - 0"		10"	# 4 @ 6"
7' - 1" to 8' - 0"		12"	# 5 @ 8"

NOTES

1. Concrete shall be 564 - C - 3000 unless otherwise noted.
2. Reinforcing steel shall comply with this drawing unless otherwise specified.
3. Reinforcing steel shall be intermediate grade deformed bars conforming to latest ASTM specifications.
4. Bends shall be in accordance with latest ACI code.
5. Minimum splice length for reinforcing shall be 30 diameters.
6. Floor shall have a wood trowel finish and, except where used as junction boxes, shall have a minimum slope of 1" per foot toward the outlet.
7. Depth V is measured from the top of the structure to the flowline of the box.
8. Wall thickness and reinforcing steel required may be decreased in accordance with table above.
9. Wall thickness shall be stepped on the outside of the box.
10. When the structure depth V exceeds 4', steps shall be cast into the wall at 15 inch intervals from 15" above floor to within 12 inches of top of structure. Where possible place steps in wall without pipe opening, otherwise over opening of smallest diameter.

Revision	By	Approved	Date

SAN DIEGO REGIONAL STANDARD DRAWING

INLETS AND CLEANOUTS NOTES AND DETAILS

RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

Allan A Kerchenal Dec. 1975
Coordinator R.C.E. 19807 Date

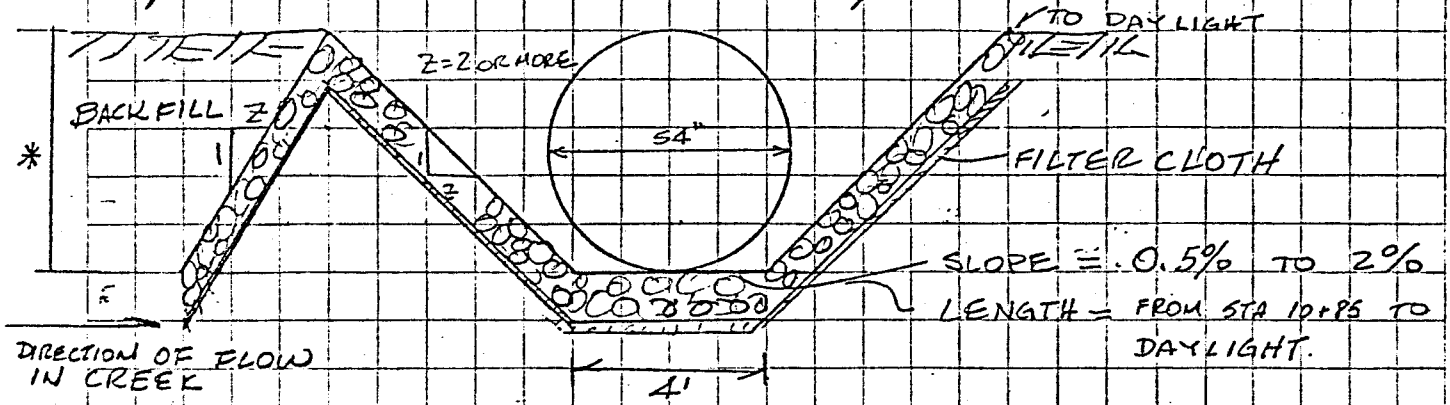
DRAWING NUMBER D-11

Boyle Engineering Corporation

BY RS DATE 5/21/82 SUBJECT CRANDALL CY MINE SHEET NO. 8 OF 9
CHKD. BY ____ DATE ____ STORM DRAIN PIPE JOB NO. BM-601-001-00

• RIPRAP DESIGN @ END OF 54" OUTLET PIPE.—

SOURCE: U.S. Dept. of Transp. "Use of Riprap for Bank protection" Reprinted in April 1970



Outlet velocity = 9 ft/sec depth ≅ 2.7 SAY 3'

assume $d_{50} = 6''$ $\frac{\text{Stone Diam}}{\text{Total depth}} = \frac{k}{d} = \frac{.5}{3} = 0.17$

USING FIG 1. $\frac{V_s}{V} = 0.58 \Rightarrow V_s = 9 \times 0.58 = V_s = 5.22$

USING FIG 2. $d_{50} \approx 6''$

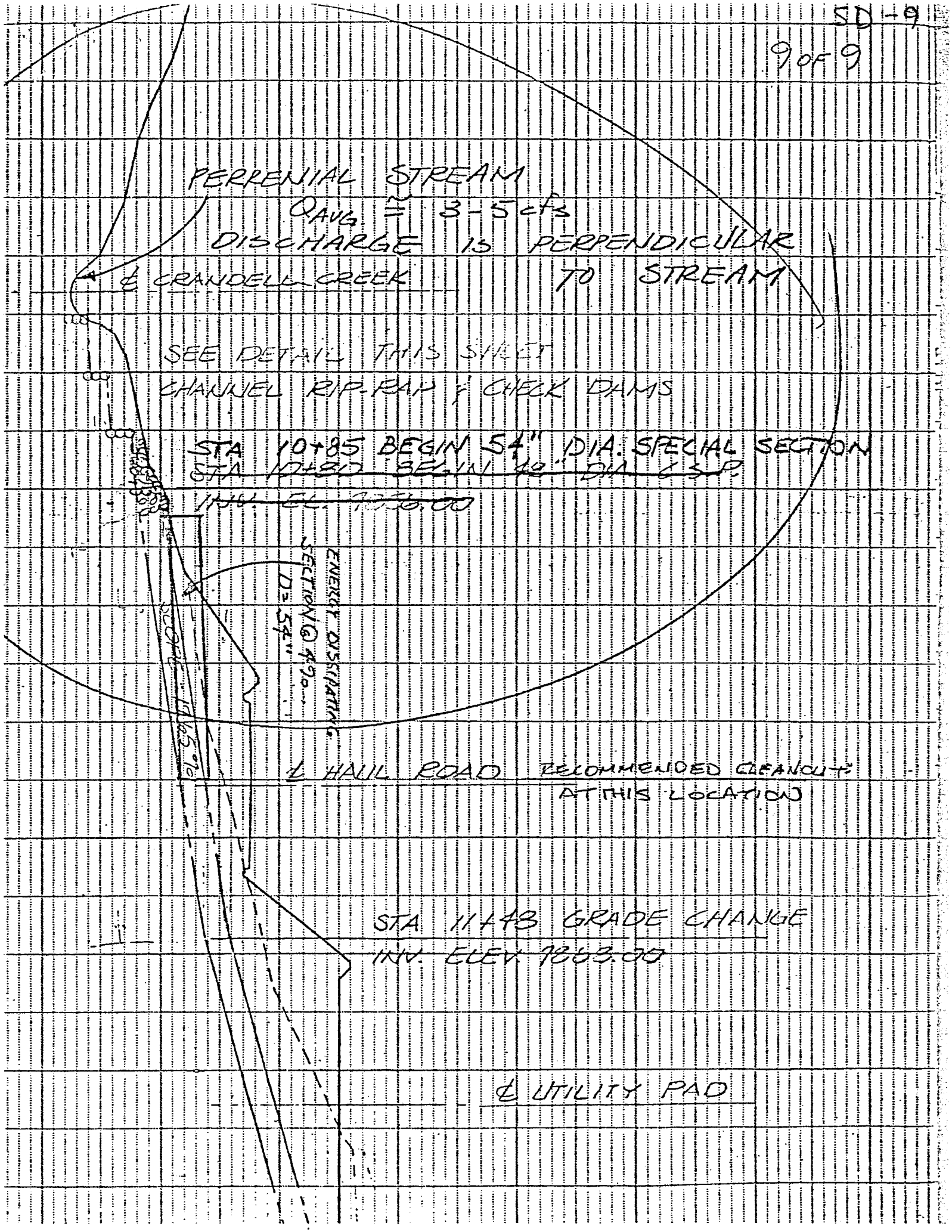
GRADATION can be specified in lb or in-diam.

OR

ROCK SIZES	PERCENTGE LARGER THAN	ROCK SIZES	% SMALLER THAN GIVEN SIZE BY WEIGHT
75 lb	0-5	12"	100
25 lb	25-75	9"	35-55
5 lb	90-100	2"	10

EITHER ONE WILL WORK. USE AT LEAST 12" OF RIPRAP AND ADD FILTER CLOTH UNDER IT. THE GRADATION SHOWN IN DRWG G01-C-019 WILL ALSO WORK FOR THE 9 Ft/sec, d ≅ 3' CONDITIONS.

* CUT-OFF-WALL HEIGHT WILL DEPEND ON THE CREEK'S SCOUR. WE DO NOT HAVE INFORMATION ON THIS BUT BE CONSERVATIVE.


PERRENIAL STREAM
$Q_{AVG} \cong 3-5$ cfs
DISCHARGE IS PERPENDICULAR TO STREAM
℄ CRANDELL CREEK
SEE DETAIL THIS SHEET
CHANNEL RIP-RAP & CHECK DAMS
STA 10+85 BEGIN 54" DIA. SPECIAL SECTION
~~STA 10+80 BEGIN 48" DIA. C.S.P.~~
~~INV. EL. 7056.00~~
ENERGY DISSIPATING SECTION @ 4%
D = 54"
℄ HAUL ROAD
RECOMMENDED CLEANOUT AT THIS LOCATION
STA 11+48 GRADE CHANGE
INV. ELEV. 7063.00
℄ UTILITY PAD

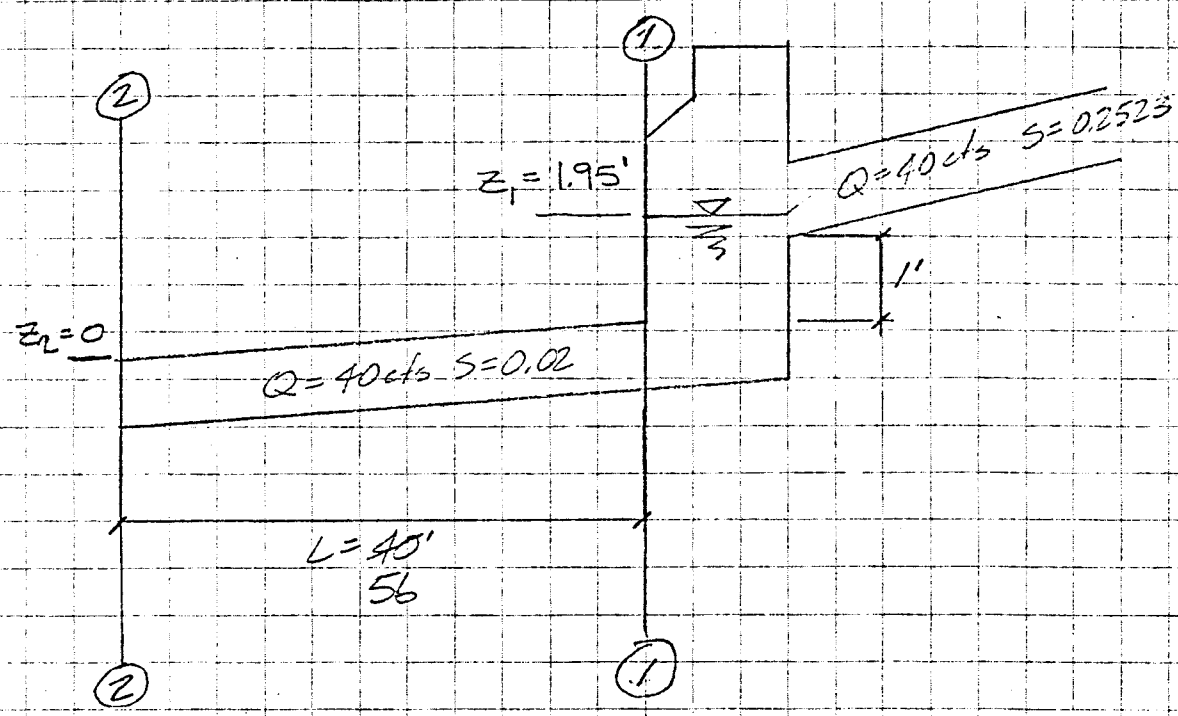
Boyle Engineering Corporation

BY DPd DATE 5/25 SUBJECT ENERGY DISSIPATOR SHEET NO. 1 OF
CHKD. BY DATE DRAINAGE ABOVE SITE JOB NO.

Q = 40 cfs
PIPE DIA = 30"

USE DROP MANHOLE CLEANOUT

S_{IN} = .2523 FT/FT S_{OUT} = .02 FT/FT



Assume Q_2 FULL PIPE FLOW
Assume $p_1 = p_2 = 0$

$$V_2 = Q/A = 40/\frac{\pi (2.5)^2}{4} = 8.15 \text{ FPS}$$

Calculate entrance loss

$$h_e = k_e \frac{V^2}{2g} \quad k_e = .5 \text{ (Flush)}$$

Boyle Engineering Corporation

BY _____ DATE _____ SUBJECT _____ SHEET NO. 2 OF _____

CHKD. BY _____ DATE _____ JOB NO. _____

$$\therefore \quad h_e = (.5)\frac{(8.15)^2}{64.4} = .52 \text{ FT}$$

Calculate loss due to friction

$$h_f = f \frac{L}{D} \frac{V^2}{2g}$$

e/D for 2.5' dia. Concrete = .002

From Moody Diagram (FULL TURBULENCE

$f = 0.024$ ✓

$$\therefore \quad h_L = .024 \frac{(56)}{2.5} \frac{(8.15)^2}{64.4} = .3961 = \underline{\underline{.4}}$$

BERNOULLI BETWEEN ① & ②

$$\alpha_1 \frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 = \alpha_2 \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2 + \Sigma h_e$$

$$z_1 = .52 + .4 + \frac{V_2^2}{2g} = 1.95' \quad \frac{2.1}{5}$$

Boyle Engineering Corporation

TELECOPIED TO DAVE ARIOTTI BEC, PRICE 5-19-82

BY JW DATE 5/17/82 SUBJECT GRANDALL CYN. HYDROL. SHEET NO. 1 OF 13

CHKD. BY RS DATE 5/18/82 JOB NO. BM-G01-001-00

• AREAS AND WEIGHTED CURVE NO. –

AREA BY COLOR*	LAND COVER	CN	PARTIAL AREA (AC)	AREA (AC)	CN × AREA
RED (1)	STEEP SLOPES	90	.291	1.644	147.96
(2)			.668		
(3)			.685		
GREEN (1)	REVEGETATED	76	.291	0.44	33.44
(2)			.149		
YELLOW (1)	NATIVE VEG.	73	.227	2.228	162.644
(2)			1.427		
(3)			.574		
BLUE	GRAVEL Rd.	90	3.582	3.582	322.36
—	POND AREA	100	0.469	0.469	46.9
TOTAL				8.363	713.324

• WEIGHTED CN = 713.32/8.36 = 85.3 ≈ 85

• TOTAL CONTRIBUTING AREA = 8.36 Ac.

• TOTAL AREA = 9.65 Ac.

*USING COLORED SHEET No. 016

Boyle Engineering Corporation

BY PS DATE 5/17/82 SUBJECT CRANDALL CYN SHEET NO. 2 OF 13
CHKD. BY ____ DATE ____ JOB NO. BM-601-D01-00

• RUNOFF VOLUMES AND HYDROGRAPHS.-

FROM NOAA ATLAS 10-YR RAINFALL = 2.4 IN
25-YR RAINFALL = 3.0 IN

2.4 IN OF RAINFALL $\xrightarrow{CN = 85}$ 1.1 IN OF RUNOFF*

3.4 IN OF RAINFALL $\xrightarrow{CN = 85}$ 1.59 IN OF RUNOFF*

* SEE SHEET 3

- 10-YR RUNOFF VOL. = 1.1 IN x 8.36 Ac x 1/12 = 0.77 Ac-Ft OR 33,400 Ft^3

- 25-YR RUNOFF VOL. = 1.59 IN x 8.36 Ac x 1/12 = 1.11 Ac-Ft OR 48,250 Ft^3

	STORAGE (Ft^3)	STORAGE CUMM. (Ft^3)	WATER LEVEL (Ft)
SED. VOLUME	13,000	13,000	7771.0*
10-YR RUNOFF VOL	33,400	46,400	7781.2*
25-YR RUNOF VOL	48,250	61,250	7785.8*

*THESE ELEVATIONS ASSUME NO OUTFLOW

P-3
3/13

CURVE
85

RUNOFF FOR INCHES OF RAINFALL

(Curve No. 85)

Inches \ Tenths	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.06	0.09	0.13
1	0.18	0.22	0.28	0.33	0.39	0.45	0.52	0.59	0.65	0.73
2	0.80	0.87	0.95	1.02	1.10	1.18	1.26	1.34	1.42	1.51
3	1.59	1.68	1.76	1.85	1.93	2.02	2.11	2.20	2.28	2.37
4	2.46	2.55	2.64	2.73	2.82	2.91	3.00	3.09	3.19	3.28
5	3.37	3.47	3.56	3.65	3.74	3.84	3.93	4.03	4.12	4.21
6	4.31	4.40	4.50	4.59	5.69	4.78	4.87	4.97	5.06	5.16
7	5.26	5.35	5.45	5.55	5.64	5.74	5.84	5.93	6.03	6.12
8	6.22	6.32	6.41	6.50	6.60	6.70	6.80	6.90	6.99	7.09
9	7.19	7.28	7.38	7.48	7.57	7.67	7.77	7.87	7.97	8.06
10	8.16	8.26	8.35	8.45	8.55	8.65	8.75	8.84	8.94	9.04
11	9.14	9.24	9.33	9.43	9.53	9.63	9.73	9.82	9.92	10.02
12	10.12	10.22	10.32	10.42	10.51	10.61	10.71	10.81	10.91	11.01
13	11.10	11.20	11.30	11.40	11.50	11.60	11.70	11.80	11.89	11.99
14	12.09	12.19	12.29	12.39	12.49	12.58	12.68	12.78	12.88	12.98
15	13.08	13.18	13.28	13.38	13.48	13.57	13.67	13.77	13.87	13.97
16	14.07	14.17	14.26	14.36	14.46	14.56	14.66	14.76	14.86	14.96
17	15.05	15.15	15.25	15.35	15.45	15.55	15.65	15.75	15.85	15.95
18	16.05	16.15	16.25	16.35	16.44	16.54	16.64	16.74	16.84	16.94
19	17.04	17.14	17.24	17.34	17.44	17.54	17.64	17.74	17.84	17.94
20	18.03	18.13	18.23	18.33	18.43	18.53	18.63	18.73	18.83	18.93

NOTE: Runoff value determined by equation $Q = \frac{(P-0.2\,S)^2}{P + 0.8\,S}$

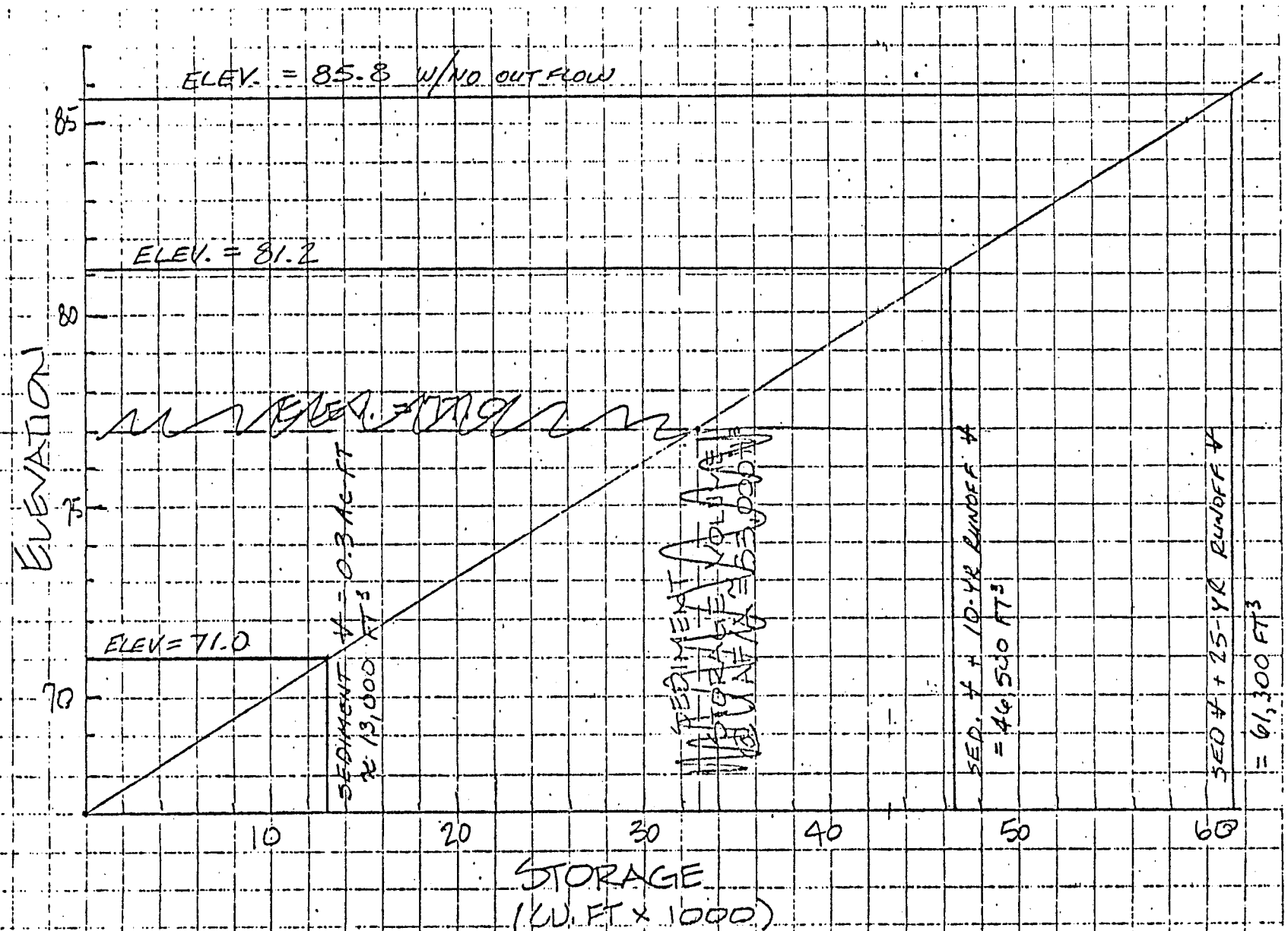
REFERENCE: Hydrology Guide

EXAMPLE: 4.50 inches rainfall = 2.91 inches runoff.

Boyle Engineering Corporation

BY _____ DATE _____ SUBJECT GENERAL SEDIMENT POND SHEET NO. 4 OF 13

CHKD. BY _____ DATE _____ JOB NO. BM-601-001-00



STORAGE VS. ELEVATION
TOTAL POND

Boyle Engineering Corporation

BY JW DATE 5/17/82 SUBJECT CRANDALL SHEET NO. 5 OF 13
CHKD. BY _____ DATE _____ JOB NO. BM-601-001-00

TIME OF CONCENTRATION

$L = 26.0'' = 1300\ FT = 0.25\ MI$
$L_{ca} = 18.2'' = 910\ FT = 0.17\ MI$
$H_1 = 7959$
$H_2 = 7785$ (MAX WSEL, SED. POND DETAIL)
$\Delta H = 174\ FT$
$S = 69\%\ FT/MI$
* $\bar{n} = 0.028$
$LAG = 24\bar{n}\left(\frac{L \cdot L_{ca}}{S^{1/2}}\right)^{0.38} = 24(0.028)\,0.0868 = 0.058\ HRS$
$T_c = LAG \times 1.51 \times 0.862 = 0.076\ HRS$ SAY 0.1 HRS

AVERAGE VEL $= \frac{1300\ FT}{0.1\ HR} \times \frac{1\ HR}{3600\ SEC} = 3.6\ FT/SEC.$ OK.

* AREA-WEIGHTED n VALUE: (SEE SHEET 4)

	COMPOSITE $\bar{n}$
20.8% STEEP SLOPES (RED), $\bar{n} = 0.025$	0.52
5.6% REVEGETATED (GREEN), $\bar{n} = 0.04$	0.224
28.2% NATIVE VEG. (YELLOW), $\bar{n} = 0.04$	1.128
45.4% GRAVEL ROAD (BLUE), $\bar{n} = 0.02$	0.908
$\bar{n} =$	2.78
$\div 100 =$	0.028

USING "URBAN HYDROLOGY FOR SMALL WATERSHEDS, TECHNICAL RELEASE No. 55"

Boyle Engineering Corporation

BY JW DATE 5-19-82 SUBJECT CRANDALL SHEET NO. 6 OF 13
CHKD. BY _____ DATE _____ JOB NO. BM-601-001-00

10-YR INFLOW HYDROGRAPH. SEE TABLE 5-3 (ATTACHED) FOR STORM DISTRIBUTION (CSM/IN)

DEPTH OF RUNOFF = 1.1"
DRAINAGE AREA = 8.36 ACRES = 0.013 SQ MI.

TIME (HRS)	Q (CFS)
	0.
11.0	0.345
11.5	0.733
11.7	4.296
11.8	14.239 ← PEAK
11.9	10.719
12.0	6.853
12.1	3.348
12.2	2.184
12.3	1.897
12.4	1.739
12.5	1.595
12.6	1.221
12.7	1.063
12.8	1.006
12.9	0.977
13.0	0.934
13.2	0.747
13.5	0.690
14.0	0.560
14.5	0.474
15.0	0.417
16.0	0.345
18.0	0.259
20.0	0.201
32.	0.

$V = 1.1'' \times \frac{1'}{12''} \times 8.36 \text{ ACRES} = \underline{0.764 \text{ AC-FT}}$

$\times 43{,}560 \frac{FT^3}{AC} = \underline{33{,}381 \ FT^3}$

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)

TIME OF CONCENTRATION = 0.1 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	24	51	299	991	746	477	233	152	132	121	111	85	74	70	68	65	52	48	39	33	29	24	18	14
0.25	20	38	66	140	327	626	686	546	364	236	169	137	117	97	83	75	66	52	41	35	30	24	18	14
0.50	15	27	36	43	67	133	288	482	580	543	429	310	222	168	134	110	81	63	47	38	32	26	19	15
0.75	12	20	25	29	34	42	65	125	245	392	496	515	452	360	273	206	127	80	53	42	35	27	19	15
1.00	9	15	19	21	24	28	32	41	63	115	209	328	427	470	451	389	245	121	64	47	38	29	20	16
1.50	6	10	12	13	14	16	17	19	22	25	29	38	56	92	154	236	410	360	133	66	47	33	21	16
2.00	3	6	7	8	9	10	11	12	13	14	16	18	20	23	27	34	74	244	371	142	68	38	23	17
2.50	2	4	4	5	5	6	7	7	8	9	10	11	12	13	15	16	21	41	243	343	150	48	26	19
3.00	1	2	2	3	3	4	4	4	5	5	6	7	7	8	9	10	12	17	50	239	321	74	29	20
3.50	0	1	1	1	1	2	2	2	3	3	4	4	4	5	6	6	7	10	17	59	304	159	33	21
4.00	0	0	0	0	0	1	1	1	1	2	2	2	2	3	3	4	5	6	10	18	67	290	39	23

TIME OF CONCENTRATION = 0.2 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	23	47	208	509	796	641	424	245	170	138	121	104	85	75	71	68	56	49	40	34	29	24	18	14
0.25	18	34	49	91	196	419	603	627	486	341	235	173	138	114	96	83	70	55	43	36	31	25	18	15
0.50	14	24	32	37	50	87	181	341	490	545	497	397	296	219	167	133	92	67	49	39	33	26	19	15
0.75	11	18	23	26	30	36	49	84	161	284	409	491	481	422	340	263	157	89	56	43	36	27	19	15
1.00	9	14	18	20	22	25	29	35	48	79	143	240	347	426	452	427	299	147	69	49	39	29	20	16
1.50	5	9	11	12	13	14	16	18	20	23	26	32	43	67	110	176	330	399	159	72	50	33	22	17
2.00	3	6	7	7	8	9	10	11	12	13	15	16	18	21	24	29	56	192	363	168	75	40	24	18
2.50	1	3	4	5	5	6	6	7	7	8	9	10	11	12	13	15	19	33	200	337	174	51	26	19
3.00	0	2	2	2	3	3	4	4	5	5	6	6	7	8	8	9	11	15	40	203	316	82	29	20
3.50	0	0	1	1	1	2	2	2	2	3	3	4	4	5	5	6	7	9	16	46	300	180	34	22
4.00	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	3	4	6	9	16	53	286	41	24

Boyle Engineering Corporation

BY JW DATE 5/18/82 SUBJECT CRANDALL SHEET NO. 8 OF 13
CHKD. BY ____ DATE ____ JOB NO. BM-601-001-00

25-YR INFLOW HYDROGRAPH (SAME STORM DISTRIBUTION AS 10-YR)

DEPTH OF RUNOFF = 1.59"
D.A. = 8.36 ACRES = 0.013 SQ. MI.

TIME (HRS)	Q (CFS)
11.0	0.499
11.5	1.060
11.7	6.212
11.8	20.590 ← PEAK
11.9	15.500
12.0	9.911
12.1	4.841
12.2	3.158
12.3	2.743
12.4	2.514
12.5	2.306
12.6	1.766
12.7	1.537
12.8	1.454
12.9	1.413
13.0	1.350
13.2	1.080
13.5	0.997
14.0	0.810
14.5	0.686
15.0	0.603
16.0	0.499
18.0	0.374
20.0	0.291
47.	0. → should be reduced

0 - 0.

$\forall = 1.59'' \times \frac{1'}{12''} \times 8.36\ AC = \underline{\underline{1.108\ AC\text{-}FT}}$

$\times\ 43{,}560\ \frac{FT^2}{AC} = \underline{\underline{48{,}251\ FT^3}}$

Boyle Engineering Corporation

BY RS DATE 5/18/82 SUBJECT CRANDALL SHEET NO. 9 OF 13
CHKD. BY ____ DATE ____ JOB NO. BM-G01-001-

• DETENTION TIME FOR 10-YR HYDROGRAPH

- A 1" ORIFICE WILL BE SET AT ELEVATION 7771.5 Ft
- ASSUMME WATER WILL REACH ELEVATION 7781.2, INSTANTANEOUSLY.

TOTAL HEAD ON ORIFICE $7781.2 - 7771.5 = 9.7$ Ft

$$Q = CA\sqrt{2gh} = 0.7\left(\frac{\pi\left(\frac{1}{12}\right)^2}{4}\right)\sqrt{(2)(32.2)(9.7)}$$

$$Q = 0.0954 \text{ cfs}$$

TOTAL TIME REQUIRED TO EMTY THE 10-YR VOL (T)

$$T = \frac{33{,}400 \text{ Cu Ft}}{0.0954 \frac{\text{cu ft}}{\text{sec}} \times \frac{3600 \text{ sec}}{1 \text{ Hr}}}$$ 12 92 Hr

$T = 97.2$ Hrs CENTROID TIME $= 97.2/2 = 48.6$

- CENTROID OF 10-YR INFLOW HYDROGRAPH OCCURS AT ABOUT 13½ HOURS AFTER BEGINNING OF RAIN

- CENTROID OF 10-YR, CONSTANT OUTFLOW HYDROGRAPH, OCCURS AT 48.6 HOURS AFTER BEGINNING OF RAIN

- DETENTION TIME $48.6 - 13.2 = 35.6$ HOURS

35.6 HOURS > 24 HOURS OK

Boyle Engineering Corporation

BY RS/JW DATE 5/8/ SUBJECT CRANDALL SHEET NO. 10 OF 13
CHKD. BY ____ DATE ____ JOB NO. BA-601-001-00

• ROUTING THE 25-YR INFLOW HYDROGRAPH.—

STAGE (FT)	STORAGE (KUFT.)	DISCH. (CFS)	REMARKS
71	0.	0	
72	3,200.	0.022	
73	6,400.	0.038	
74	9,600.	0.048	
75	12,800.	0.057	
76	16,000.	0.065	
77	19,200.	0.072	
78	22,400.	0.078	
79	25,600.	0.084	
80	28,800.	0.089	
81	32,000	0.094	
81.2	—	0.095	TOP OF RISER
82.	35,200.	7.299	
83.	38,400.	7.604	
84.	41,600.	7.808	OUTLET PIPE CONTROLS DISCHARGE
85.	44,800.	8.013	
86.	48,000	8.217	

- AFTER ROUTING 25-YR HYDROGRAPH, THE MAX WATER SURFACE ELEVATION IS APPROXIMATELY 7784.3 FT FOR A PEAK OF 1.65 cfs.
- THE OUTFLOW HYDROGRAPH IS A VERY LONG HYDROGRAPH WITH AN APPROXIMATE AVERAGE FLOW OF 0.07 cfs

25-YR, 24 Hr
OUTFLOW
HYDROGRAPH

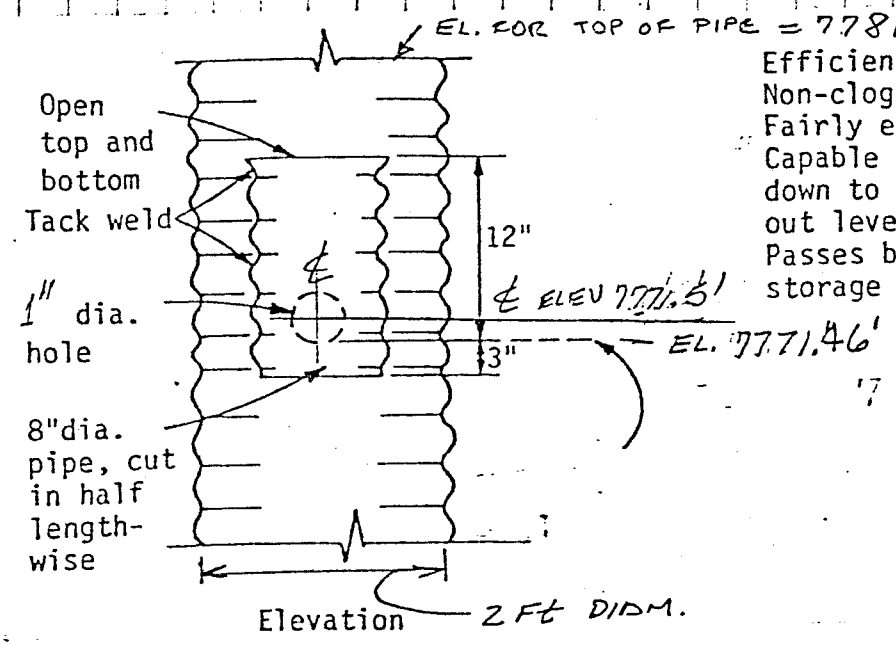
TIME (HR)	OUTFLOW (CFS)
11.1	.0000
11.2	.0000
11.3	.0000
11.4	.0000
11.5	.0012
11.6	.0062
11.7	.0173
11.8	.0404
11.9	.0587
12.0	.0689
12.1	.0736
12.2	.0760
12.3	.0776
12.4	.0789
12.5	.0802
12.6	.0811
12.7	.0818
12.8	.0824
12.9	.0830
13.0	.0836
13.1	.0842
13.2	.0847
13.3	.0852
13.4	.0857
13.5	.0860
13.6	.0859
13.7	.0859
13.8	.0858
13.9	.0858
14.0	.0857
14.1	.0857
14.2	.0856
14.3	.0856
14.4	.0855
14.5	.0855
14.6	.0854
14.7	.0854
14.8	.0854
14.9	.0853
15.0	.0853
15.1	.0852
15.2	.0852
15.3	.0851
15.4	.0851
15.5	.0850
15.6	.0850
15.7	.0849
15.8	.0849
15.9	.0848
16.0	.0848
16.1	.0847
16.2	.0847
16.3	.0846
16.4	.0846
16.5	.0845
16.6	.0845
16.7	.0844
16.8	.0844
16.9	.0843
17.0	.0843

Boyle Engineering Corporation

BY RS DATE 5/9/82 SUBJECT CRANDALL SHEET NO. 12 OF 13
CHKD. BY ____ DATE ____ JOB NO. BM-601-001-00

• PROPOSED RISER

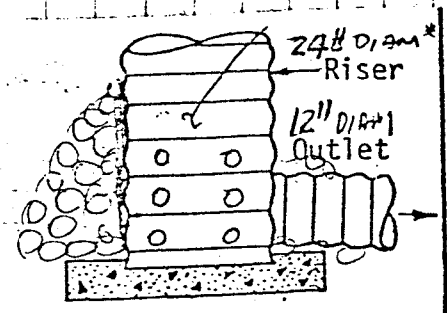
STAND PIPE 2 Ft DIA CSP
OULET PIPE 6 IN DIA CSP
1 IN SINGLE PERFORATION WITH SKIMMER @ EL. 7771.5 Ft
MAX ELEVATION



Efficient skimmer
Non-clogging
Fairly easy to construct
Capable of draining down to sediment clean-out level
Passes base flow without storage of water

Source: USDA-SCS Plate 1.26o

FILTER FABRIC WRAPPED AROUND RISER OULET AND PROTECTED BY ROCK.



Riser Connection

FOR FIG. 6.11 OF METHODS FOR MEETING OSM REQUIREMENTS BY SKELLY & LOY

NUMBER

(6) $(H+35)/5 = (7787-7769+35)/5 \cong 11'$

(7) $0.05\,H = 0.05 \times 18 = 0.9'$ SAY 1'

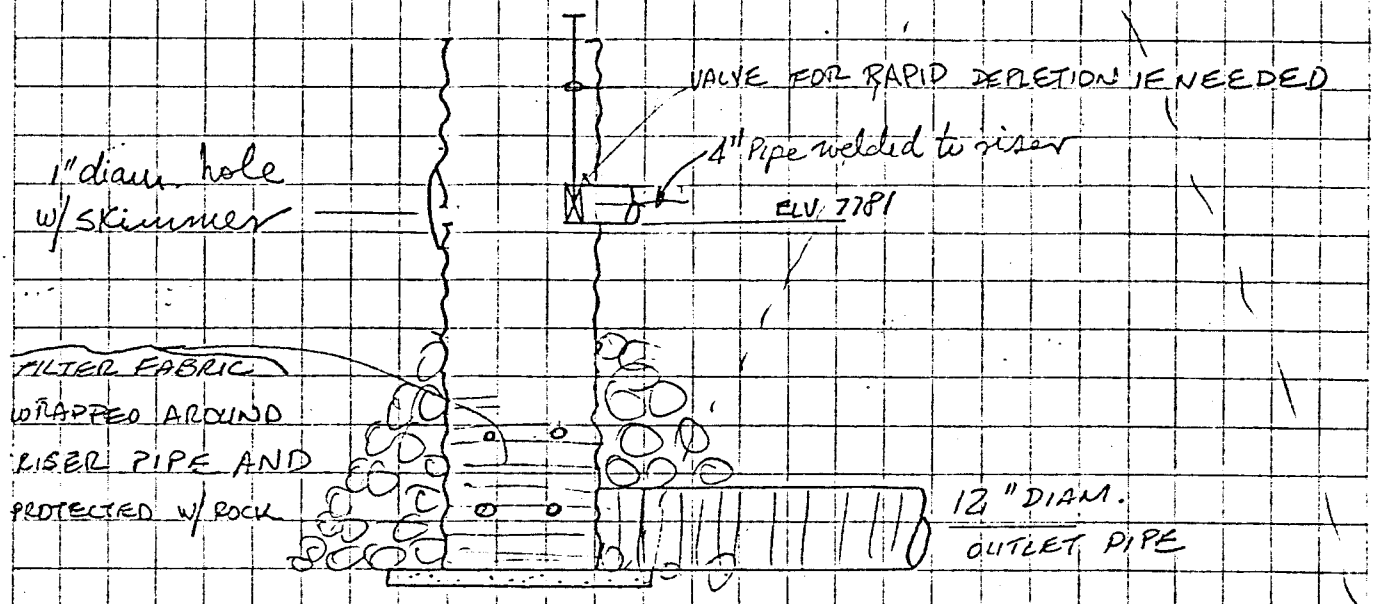
(10) $H = 7787 - 7769 = 18$ Ft

NOTE: IF RISER NEEDS TO BE BIGGER TO MAINTAIN IT BETTER, INCREASE IN SIZE WILL NOT AFFECT THE CALCULATIONS

Boyle Engineering Corporation

BY RS DATE 5/19/82 SUBJECT CRANDALL SHEET NO. 13 OF 13
CHKD. BY ____ DATE ____ JOB NO. BM-G01-001.00

• OPTIONAL OUTLET (RECOMMENDED)



• SUMMARY.-

	DIA (IN)	VOLUME (Ft³)	CUM. STORAGE (Ft³)	MAX. WATER SURF. ELEV. (Ft)
- SED. VOL.		13,000	13,000	7771.0
- 10-YR. RUNOFF VOL		33,400	46,400	7771.82
- 25-YR RUNOFF VOL		48,250	61,250	[illegible]
- TOP OF RISER PIPE		—	—	7771.32
- MIN. DIA. OF RISER PIPE	24	—	—	—
- OUTLET PIPE	12	—	—	—

* ROUTED

Boyle Engineering Corporation

SUPPLEMENT TO HYDROLOGY CALC. SHEETS 1/13 - 13/13

BY JW DATE 5-19-82 SUBJECT CRANDALL CANYON MINE SHEET NO. 1 OF 5
CHKD. BY ____ DATE ____ DETENTION POND-ROUTING JOB NO. BM-601-001-00

ELEVATION-STORAGE-DISCHARGE (SEE ATT. STORAGE CURVE)

USING SINGLE 1" DIA. ORIFICE

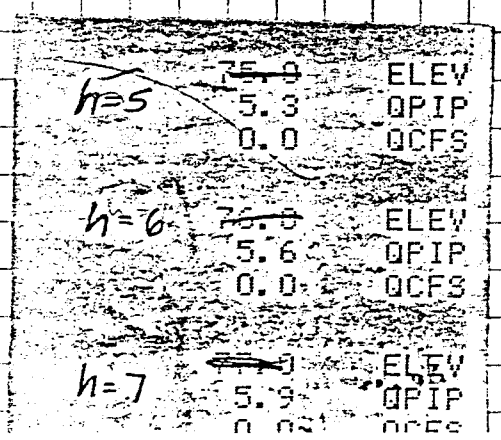
	ELEV.	h_o	Q_o	h_{pr}	Q_{pr}	Q_{pip}	h_w	Q_w	Q_{TOT}	STOR.
SED. EL	78.5	-	-	-	-	-	-	-	-	0
& ORIFICE	79	0	0	-	-	0	-	-	0	2000.
	80	1	0.031	-	-	0.031	-	-	0.031	5200
	81	2	0.043	-	-	0.043	-	-	0.043	10,200
	82	3	0.053	-	-	0.053	-	-	0.053	15,000
	83	4	0.061	-	-	0.061	-	-	0.061	23,000
PR. SP'WY.	84	5	0.069	0	0	0.069	-	-	0.069	33,500
EM. SP'WY.	85	6	0.075	1	19.478	5.45	0	0	5.45	39,500
	85.5	6.5	0.078	1.5	35.783	5.6	0.5	6.109	11.709	45,000
	86	7	0.081	2	55.092	5.75	1	17.280	23.03	50,000

ORIFICE FLOW: $Q_o = CA\sqrt{2gh_o} = \underbrace{0.7\left(\frac{\pi(\frac{1}{12})^2}{4}\right)\sqrt{2(32.2)}}_{0.0306}\sqrt{h_o}$

WEIR FLOW @
PR. SP'WY. : $Q_{pr} = CLh_{pr}^{3/2} = \underbrace{3.1(\pi(2))}_{19.478} h_{pr}^{3/2}$

FLOW IN 1FT-DIAM. DRAWDOWN PIPE: SEE CALCULATOR PRINTOUT (Q_{PIP})

WEIR FLOW @
EMERGENCY SP'WY. : $Q_w = CLh_w^{3/2} = \underbrace{2.88(6)}_{17.28} h_w^{3/2}$

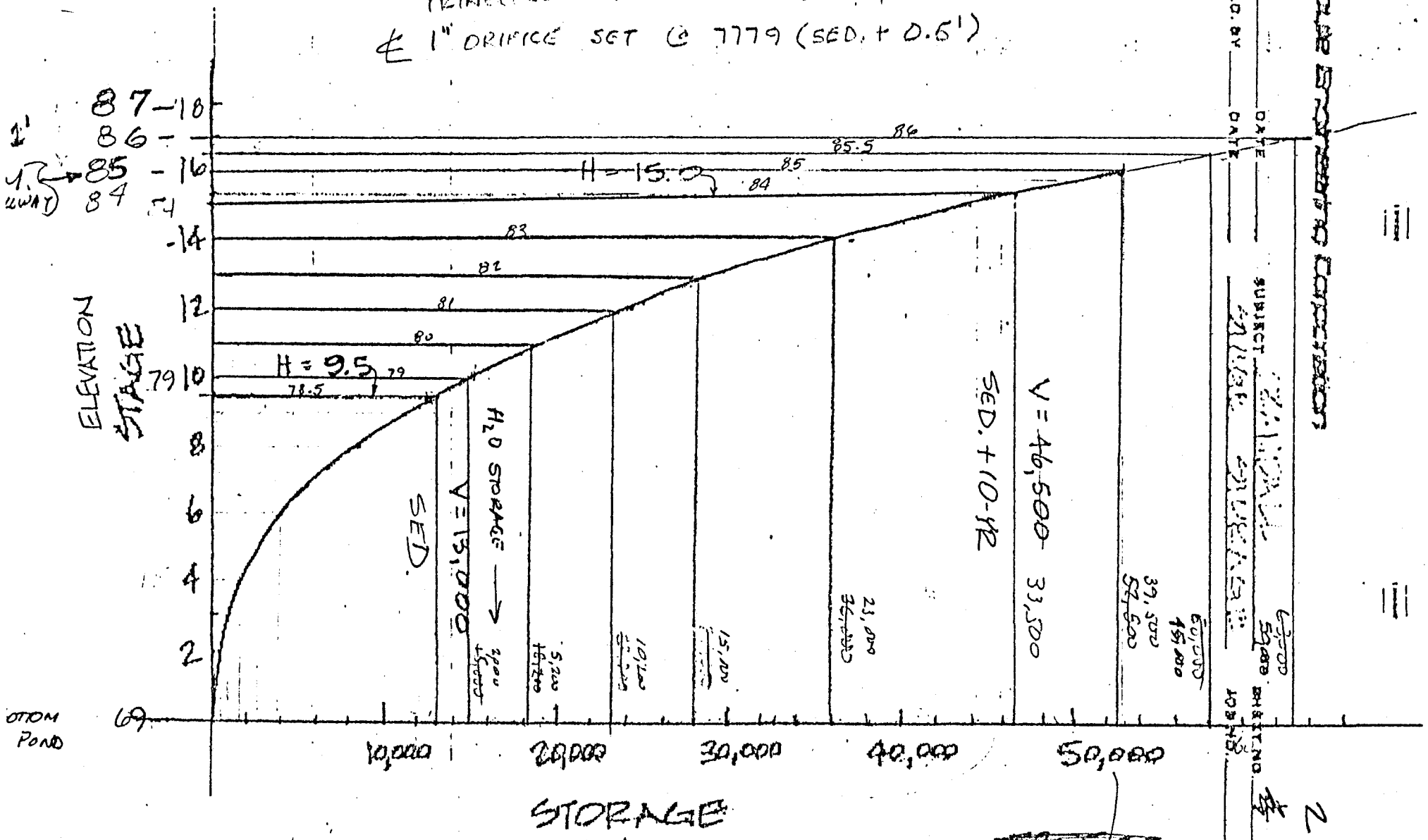


DRAWDOWN PIPE CALCS.

EMERGENCY SET @ 7785'

PRIMARY SPWAY. SET @ 7784' (10-YR + SED)

℄ 1" ORIFICE SET @ 7779 (SED. + 0.6')



MAX POND VOL. = ~~52,500~~ ~~53,500 FT³~~ ~~63,000 FT³~~ 63,000 FT³ (ELEV = 86)

10-YR INFLOW/OUTFLOW HYDROGRAPHS

TIME (HRS)	10-YR INFLOW (CFS)	10-YR OUTFLOW (CFS)	WATER SURF. ELEV.
10.50	.29	.03	80.00
10.60	.29	.03	80.02
10.70	.29	.03	80.04
10.80	.29	.03	80.06
10.90	.30	.03	80.07
11.00	.30	.03	80.09
11.10	.38	.03	80.12
11.20	.46	.03	80.14
11.30	.54	.03	80.18
11.40	.62	.03	80.22
11.50	.70	.03	80.26
11.60	2.25	.04	80.37
11.70	3.80	.04	80.58
11.80	12.70 ← PEAK	.04	81.18
11.90	9.50	.05	82.00
12.00	6.10	.06	82.35
12.10	3.00	.06	82.56
12.20	1.90	.06	82.66
12.30	1.70	.06	82.74
12.40	1.50	.06	82.81
12.50	1.40	.06	82.87
12.60	1.10	.06	82.93
12.70	.90	.06	82.97
12.80	.90	.06	83.01
12.90	.90	.06	83.03
13.00	.80	.06	83.06
13.10	.75	.06	83.09
13.20	.70	.06	83.11
13.30	.67	.06	83.13
⋮	⋮	⋮	⋮
25.10	.11	.07	83.85
25.20	.11	.07	83.85
25.30	.11	.07	83.85
25.40	.11	.07	83.85
25.50	.11	.07	83.86
25.60	.11	.07	83.86
25.70	.10	.07	83.86
25.80	.10	.07	83.86
25.90	.10	.07	83.86
26.00	.10	.07	83.86
26.10	.10	.07	83.86
26.20	.10	.07	83.86
26.30	.09	.07	83.87
26.40	.09	.07	83.87
26.50	.09	.07	83.87
26.60	.09	.07	83.87
26.70	.09	.07	83.87
26.80	.09	.07	83.87
26.90	.08	.07	83.87
27.00	.08	.07	83.87
27.10	.08	.07	83.87
27.20	.08	.07	83.87
27.30	.08	.07	83.87
27.40	.08	.07	83.87
27.50	.07	.07	83.87
27.60	.07	.07	83.87
27.70	.07	.07	83.87
27.80	.07	.07	83.87

MAX. ELEV. = 7783.87

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147.60	.00	.04	80.67
147.70	.00	.04	80.67
147.80	.00	.04	80.66
147.90	.00	.04	80.66
148.00	.00	.04	80.66
148.10	.00	.04	80.66
148.20	.00	.04	80.65
148.30	.00	.04	80.65
148.40	.00	.04	80.65
148.50	.00	.04	80.64
148.60	.00	.04	80.64
148.70	.00	.04	80.64
148.80	.00	.04	80.64
148.90	.00	.04	80.63
149.00	.00	.04	80.63
149.10	.00	.04	80.63
149.20	.00	.04	80.63
149.30	.00	.04	80.62
149.40	.00	.04	80.62
149.50	.00	.04	80.62
149.60	.00	.04	80.61
149.70	.00	.04	80.61
149.80	.00	.04	80.61
149.90	.00	.04	80.61
150.00	.00	.04	80.60

PEAK OUTFLOW	=	.07
FINAL OUTFLOW	=	.04
PEAK ELEVATION	=	83.87
CENTROID IN	=	13.51
CENTROID OUT	=	74.28
VOLUME IN	=	36846.01 ✓
VOLUME OUT	=	28637.67

10-YR HYDROGRAPH ROUTING SUMMARY

END OF PROGRAM

DETENTION TIME

= 74.28 - 13.51

≈ 61 HRS > 24 ✓

COMPLETE RUN & OUTPUT
SENT TO BEC, UT
(DAVID ARCOTT) 5-21-82

TIME (HRS)	25-YR INFLOW (CFS)	25-YR OUTFLOW (CFS)	WATER SURF. ELEVATION
11.30	.84	.04	80.96
11.40	.95	.04	81.03
11.50	1.06	.04	81.10
11.60	3.64	.05	81.27
11.70	6.21	.05	81.64
11.80	20.59 ← PEAK	.06	82.38
11.90	15.50	.06	83.15
12.00	9.91	.07	83.58
12.10	4.84	.07	83.83
12.20	3.16	.07	83.97
12.30	2.74	.59	84.10
12.40	2.51	1.15	84.20
12.50	2.31	1.50	84.27
12.60	1.77	1.65	84.29 ELEV. MAX
12.70	1.54	1.65	84.29
12.80	1.45	1.61	84.29
12.90	1.41	1.56	84.28
13.00	1.35	1.51	84.27
13.10	1.21	1.45	84.26
13.20	1.08	1.36	84.24
13.30	1.05	1.28	84.23
13.40	1.02	1.21	84.21
13.50	1.00	1.16	84.20
13.60	.96	1.11	84.19
13.70	.92	1.06	84.18
13.80	.88	1.02	84.18
13.90	.85	.98	84.17
14.00	.81	.93	84.16
14.10	.79	.90	84.15
14.20	.76	.86	84.15
14.30	.74	.83	84.14
14.40	.71	.80	84.14
14.50	.69	.77	84.13
14.60	.67	.75	84.13
14.70	.65	.72	84.12
14.80	.64	.70	84.12
14.90	.62	.68	84.11
15.00	.60	.66	84.11
15.10	.59	.64	84.11
15.20	.58	.63	84.10
15.30	.57	.61	84.10
15.40	.56	.60	84.10
15.50	.55	.59	84.10
15.60	.54	.58	84.09
15.70	.53	.57	84.09
15.80	.52	.55	84.09
15.90	.51	.54	84.09
16.00	.50	.53	84.09
16.10	.49	.52	84.08
16.20	.49	.51	84.08
16.30	.48	.50	84.08
16.40	.47	.50	84.08
16.50	.47	.49	84.08

PEAK OUTFLOW	=	1.65
FINAL OUTFLOW	=	.02
PEAK ELEVATION	=	84.29
CENTROID IN	=	13.38
CENTROID OUT	=	60.85
VOLUME IN	=	59581.45
VOLUME OUT	=	55455.66

COMPLETE RUN!
OUTPUT SENT TO
BEC, LIT (DAVE ARIOTTI)

25-YR INFLOW/OUTFLOW HYDROGRAPHS

Send to
Dave Ariotti
Utah, Price.

Boyle Engineering Corporation

BY YY DATE 5/14 SUBJECT Genwal Mine SHEET NO. 1 OF 4
CHKD. BY ____ DATE ____ Sediment Yield Cal. JOB NO. BM-601-001-00

Sediment Yield Estimation

1. Approach:

Universal Soil Loss Equation (USLE)
"SCS Agricultural Handbook No 537 (1978)"

$$A = RKLSCP$$

where
A : soil Loss in Tons/acre
R : Rainfall and runoff factor
K : Soil Erodibility factor
L : Slope - length factor
S : Slope - steepness factor
C : cover and management factor
P : Practice factor

$$Y = D.A. \times A \times DR$$

where
Y : Sediment yield in Tons
D.A. : Drainage Area in Acres
D.R. : Delivery Ratio

2. Data and Assumption

1) Drainage Area

Undisturbed		2.23	acres.
Disturbed	Reveqetated	0.44	acres
	Embankment	1.64	"
	Coal Storage	1.00	"
Road & Parking Lot (Gravel)		2.58	"
TOTAL		7.89	"

Boyle Engineering Corporation

BY _____ DATE _____ SUBJECT _____ SHEET NO. 2 OF 4
CHKD. BY _____ DATE _____ JOB NO. _____

2) The rainfall factor, R, was determined to be 20 from the above ref.

3) Soil for the site area is Kenilworth Sandy Loam for which the soil erodibility factor, K, should be .20 (Per telephone conversation with SCS Personnel in Salt Lake City). The K factor for coal pile is assumed to be .5.

4) The slope-length-steepness factor was measured from 1" = 50' topo map.

5) The cropping factor, "C", for the undisturbed area was determined to be 0.14. The factor for the disturbed area (Reveg etated and bank slope areas) is taken to be 0.5 assuming

1st year	C = 1	(no vegetation)
2nd year	C = 0.40	
3rd year	C = 0.10	
AVG.	C = 0.50	

6) The practice factor P, was taken as "1" assuming no sediment control practices

3. Results

Total Erosion Rate = 257.1 Tons (See Page 4/4)

Total Sediment Yield = Erosion Rate x Delivery Ratio

= 257.1 x 0.62*

= 159.4 Tons.

(*Note: Delivery Ratio was taken to be 0.62 according to U.S. COE Manual for "STORM", 1977)

Boyle Engineering Corporation

BY _____ DATE _____ SUBJECT _____ SHEET NO. 3 OF 4
CHKD. BY _____ DATE _____ JOB NO. _____

Sediment Storage Requirement:

Assume 3 yrs sediment Accumulation

∴ 159.4 Tons/YR x 3 YRS = 478.2 Tons

Assume the bulking weight of the sediment to be 74 lbs/cu-ft or 0.62 acre-ft/1000 tons

∴ 478.2 Tons x 0.00062 acres/tons

= **0.30 acre-feet**

4. Check with the Utah state Requirements:

The above calculation shows that the sediment yield for a 3-year period is

Undisturbed Area: 0.015 acre-feet/acre

Disturbed Area: 0.085 acre-feet/acre

This is comparable with the requirement which specifies 0.1 acre-feet for each acre of disturbed area or greater amount.

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Boyle Engineering Corporation

SHEET NO. 4 OF 4

JOB NO.

SUBJECT

BY VV DATE

CHKD. BY DATE

Sediment Yield Estimation

Reference: Universal Soil Loss Equation.
SCS Agricultural Handbook No. 537 (1978)

Land Use	Area (acres)	R (1)	K (2)	L (ft)	S (ft)	LS	C	Area x RKLSCP (4)	
Native Veg.	2.23	20	0.20	70	0.70	23.18	.14 (3)	29.7	
Revegetated	0.44	20	0.20	45	0.50	12.3	0.50	10.8	227.4
Embankment	1.64	20	0.20	40	1.0	26.31	0.50	187.6	
Coal Pile	1.00	20	0.50	50	0.5	12.9	1.0	129.0	
Road & Parking Lot - Gravel	2.58	–	–	–	–	–	–	0	
Total	7.89	–	–	–	–	–	–	257.1 Tons	

Note (1) From the above ref.
(2) Per SCS Personnel in Salt Lake City, UT
(3) Assume 25% canopy cover and 40% ground cover
(4) Assume P = 1