Chapter 7 MUCK DISPOSAL PLAN

7.1 INTRODUCTION

The proposed Sawalkote H.E. Project is located on the river Chenab. The project envisages construction of 192.5 m high Roller Compacted concrete (RCC) dam. Large quantity of material would be excavated from the Head Works, HRT during the tunneling and Power House. In addition the pressure shaft, penstock, switch yard, etc. and the approach roads would also generate a large amount of muck.

7.2 QUANTITY OF MATERIAL TO BE EXCAVATED

The muck quantity expected to be generated from various project components is given in **Table 7.1**. The total quantity of muck generated from soil and rock excavation is about **295,000 cum** and **7,435,000 cum** respectively.

Table 7. 1 Quantity of muck to be generated from different project construction activities and quantity required to be disposed off

S. No.	Component	Underground Rock excavation (Lakh m^3)	Surface Rock excavation (Lakh m^3)	Total - Rock excavation (Lakh m^3)	Soil excavation (Lakh m^3)
1	Diversion tunnels	11.4	3.5	14.9	0.3
2	Dam and plunge pool		10	10	1.6
3	Power Intake, HRTs and Pressure shafts	2.4	3.8	6.2	0.2
4	Tailrace tunnels	9.4	1.8	11.2	0.2
5	Draft tube and surge galley	4.7		4.7	0
6	Power House	4		4	0
7	Pot head yard		4.75	4.75	0.25
8	Access tunnels and construction adits	8.4	0.1	8.5	0.1
9	Infrastructure works and Misc.	6.5	3.6	10.1	0.3
Total		**46.8**	**27.55**	**74.35**	**2.95**

Quantity of total Muck generation due to Sawalkote HEP = 77.30 Lakh cum (74.35 Lakh cum –Rock + 2.95 Lakh cum Soil)

About 65% of rock excavation is expected to be used for producing coarse and fine aggregate for concrete production and in fillings for developing areas for construction facilities. Total quantity of excavation in common soil and balance 35% quantity of rock excavation would have to be disposed in muck disposal area. Thus considering swell factors 0.67 for rock and 0.75 for common soil and redeposit compaction factor of 90%, total muck disposal area should have a capacity of more than **3,406,810 cum (Table 7.2)**.

- Net Quantity of Muck to be rehabilitated/disposed off = 34.07 lakh cubic meter (Approx)

Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

Table 7. 2 Quantity of muck to be disposed

S. No.	Particulars	Common Soil (cum)	Rock (cum)
1	Total excavation	**295,000**	**7,435,000**
2	Less used in production of aggregates		4,832,750
3	Balance to be deposited	295,000	2,602,250
4	Swell factor (S)	0.75	0.67
5	Re Deposition factor (R)	0.90	0.90
6	Quantity of Redeposit of Muck (Q/S) x R	354,000	3,495,560
7	Re utilization: Compacted rock fills		4,42,750
8	Muck for Disposal	354,000	3,052,810
	Total muck to be disposed	**3,406,810 cum**	

7.3 DUMPING SITES

The identification of muck disposal areas was done in line with the topographic conditions and site specific conditions. Keeping the above requirement and vicinity of the excavation sites in view, two muck disposal areas named as MDS-1 and MDS-2 have been identified located on the left bank of Chenab river upstream of Dam site, wherein one dumping site MDS-1 is located near Pari village and other dumping site MDS-2 is located near Tangar village (**refer Figure 7.1**). Total capacity of these sites is about 48.2 lakh cum (refer **Table 7.3**). Cross sections of the two identified dumping sites are given at **Figures 7.2 – 7.3**. Both of the muck disposal sites have been identified in vicinity of the area where the muck is likely to be generated in order to minimize the cost of transport and mitigation of dust pollution which may occur during transportation.

Table 7. 3: Capacity of Muck Dumping Sites

S. No.	Dumping Site	Capacity (Cum)
1	MDS-1	555,832
2	MDS-2	4,264,236
	Total	**4,820,068**

Volume calculations of the two dumping sites are given below:

Volume calculation for MDS-1

Section line in Figure 7.1	Area (Sq m)
AA	994
BB	592
CC	922
Average area	536
Length = 1037 m	
Capacity of MDS-1 = 555832 m^3 say 5.56 lakh m^3	

Volume calculation for MDS-2

Section line in Figure 7.1	Area (Sq m)
DD	4615
EE	6848
Average area	5731.5
Length = 744 m	
Capacity of MDS-2 = 4264236 m^3 say 42.64 lakh m^3	

Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

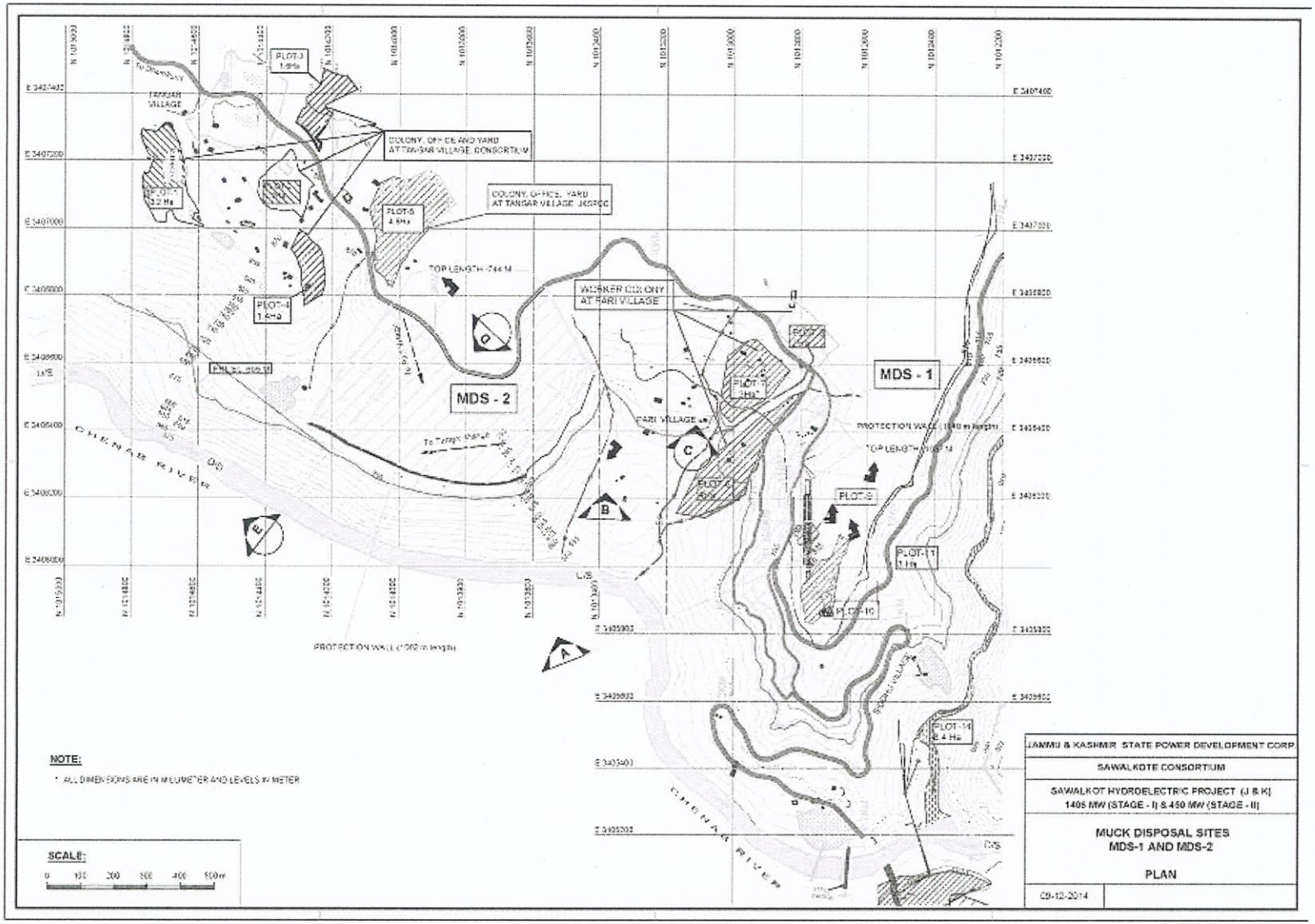


Figure 7.1 : Layout Plan of Sawalkote HE project showing muck dumping areas

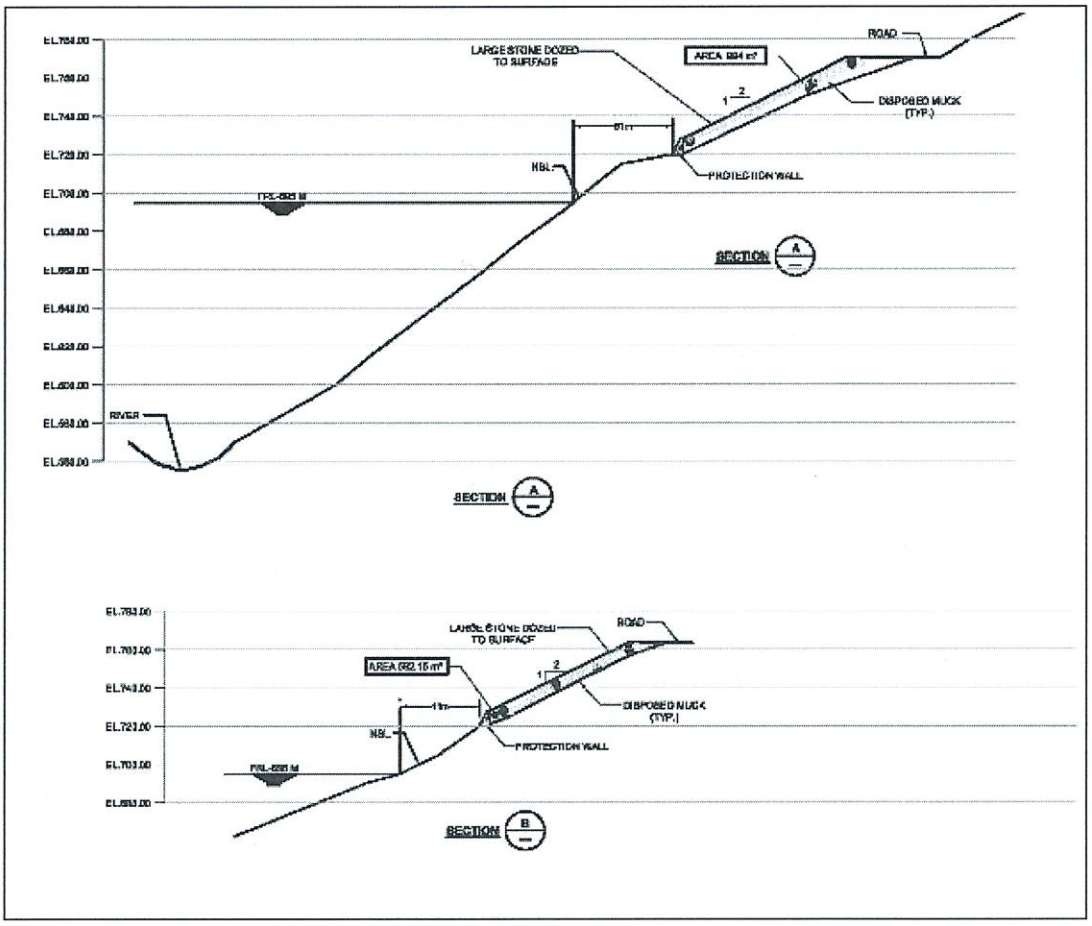
Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

These proposed locations are spread over land area of **36 ha** (MDS1- 28 ha + MDS2-8 ha). The muck that needs disposal would be piled at an angle of repose less than 30° at the proposed dumping sites. For this these slopes would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and also to provide ample space for planting of trees which would further help in holding and consolidating the material stacked at different sites. Efforts will be made to relocate and rehabilitate the material within short distances from sites of its generation. The description regarding the stabilization of the stacked material along the proposed roads has been discussed in the following paragraphs.

The dumping of the muck will be in stages allowing it to consolidate/settle through the monsoon, compacting of the dumped muck in the process of Dozer movement, zoning of the dumping judiciously to be undertaken to ensure the stability of 30° slope under all superimposed conditions.

The bottom end of the muck disposal sites are protected by providing concrete gravity retaining walls all along the bottom of muck disposal sites (**refer Figure 7.4**). The details of retaining walls are given below:

Length of concrete gravity retaining wall for MDS-1 = 1140 m
Length of concrete gravity retaining wall for MDS-2 = 1062 m
Total length of protection walls = 2202 m say 2202 Running meters
The height of the protection wall shall be average 8 m.



Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

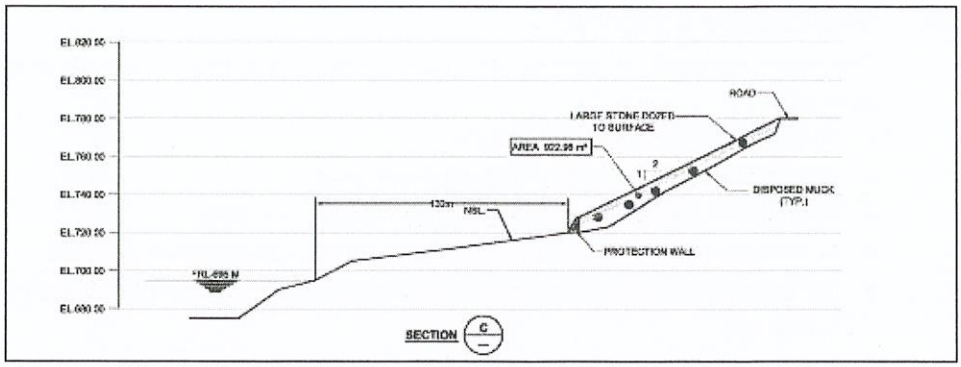


Figure 7.2: Cross sections A, B, and C of Dumping Site (MDS-1)

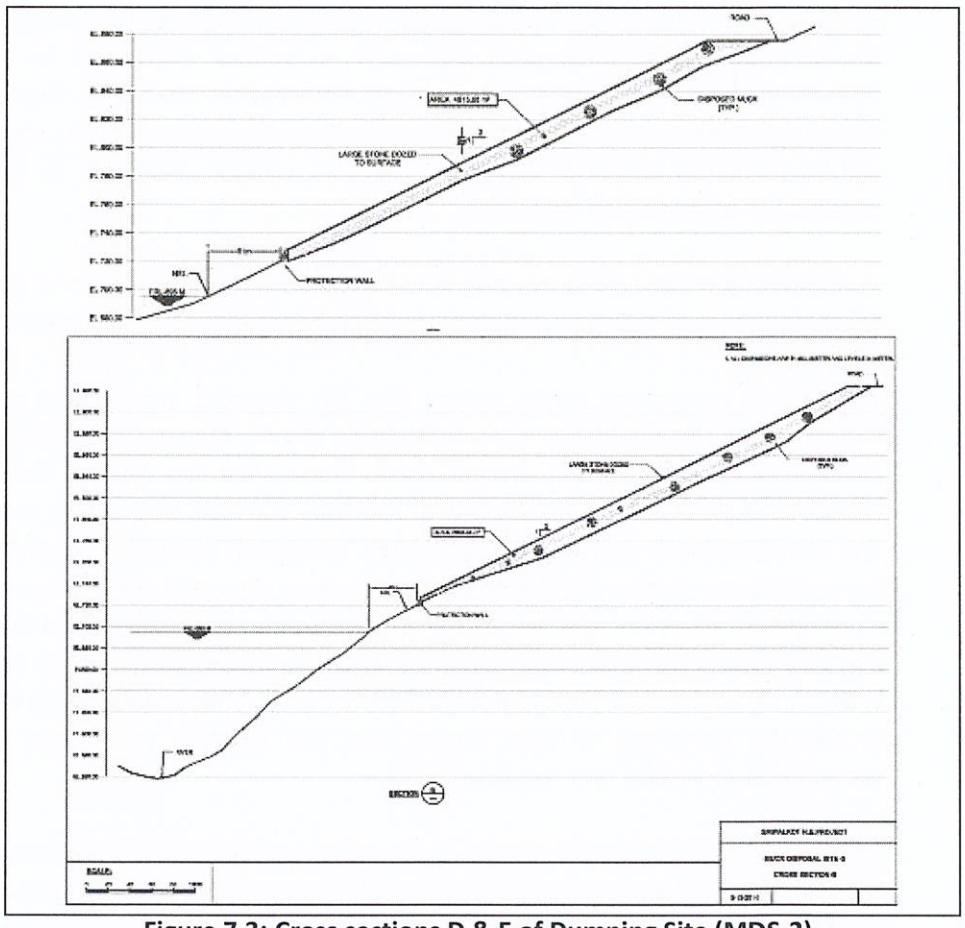


Figure 7.3: Cross sections D & E of Dumping Site (MDS-2)

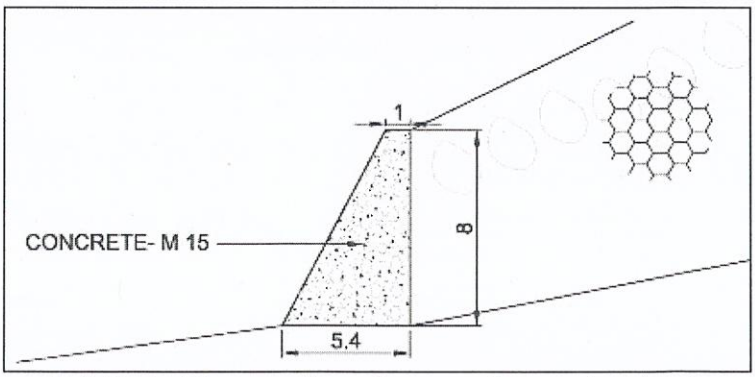


Figure 7.4: Typical Cross section of proposed concrete retaining wall

Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

7.4 PROCESS OF DUMPING

The main objectives of process of muck dumping and restoration of these muck disposal sites are:

- to protect and control soil erosion
- to create greenery in the muck disposal areas
- to improve and develop the sites into recreational sites
- to ensure maximum utilization of muck for the construction purpose
- to develop the muck disposal sites/ dumping yards to blend with the surrounding landscape
- to minimize damages due to the spoilage of muck in the project area.

Suitable retaining walls shall be constructed prior to dumping of muck and terraces would be developed so as to support the muck on vertical slope and for optimum space utilization. Loose muck would be compacted layer-wise. The muck disposal area will be developed in a series of terraces of retention walls. The terraces of the muck disposal area will be ultimately covered with fertile soil and suitable plants will be planted adopting suitable bio-technological measures.

In addition, drainage measures and land leveling shall also be required to be made. The schematic diagram of process of dumping to be adopted is given at **Figure 7.5**.

The project authorities would ensure that the dumping yards blend with the natural landscape by developing the sites with gentle slopes, bunds, terraced and water ponds, patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting ornamental plants. The re-vegetation of dumping yards through 'Integrated Biotechnological Approach' would be undertaken. It may be necessary to inoculate the spoil dumps for development of landscape as the soils would be poor in nutrients. This can be developed through culture of microorganism or vermin culture practices at the nurseries developed for this purpose. This task can be undertaken by National Environmental Engineering Research Institute, Nagpur or CEMDE, University of Delhi which have the required technology in the field of reclamation of derelict and degraded lands.

All the spoil areas will be developed as per the latest technology of dumping, the impact of rain, the time and angle of soil setting. In addition sprinkling of water may also be resorted to, if required to avoid or minimize dust pollution. Proper drainage system also has to be provided to ensure unobstructed flow of runoff. Planting with suitable species of trees, shrubs and other biomass will also be initiated.

Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

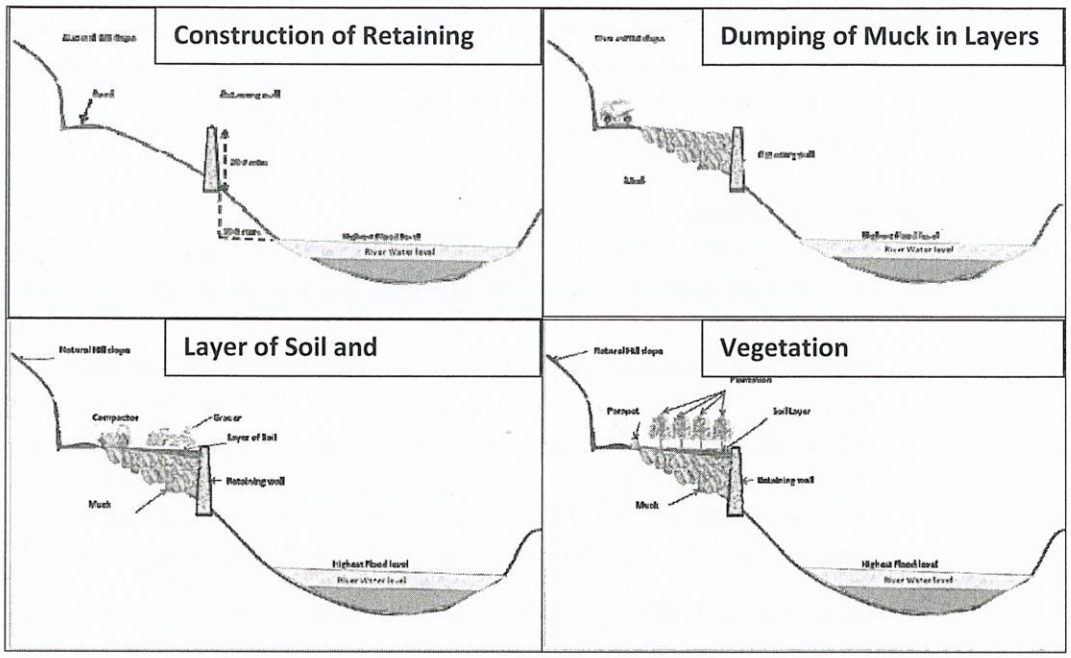


Figure 7.5: Schematic Process of Dumping

7.5 RECLAMATION MEASURES FOR STABILIZATION OF SPOIL DUMPS

The following engineering and biological measures have been proposed for the development of spoil areas.

7.5.1 Engineering Measures

For stacking of dumped material retaining walls filled with plum concrete are proposed to be built to hold the disposed muck before the dumping of any material on to the site (**refer Figure 7.5**). These retaining walls (8 m high) shall be of stone masonry filled with plum concrete for both the dumping sites. The retaining walls shall be provided in stone masonry of grade M15. The retention walls should carry weep holes for the discharge of subsurface water during rainy season. The weep holes should also carry filters at the side facing the dumped materials. In order to ensure slope stabilization, the slopes may be broken into terraces wherever required. The unit cost of these different types of retaining walls has also been given in the figure mentioned above. At MDS-1 retaining wall of 1140 rmt of 8 m high would be built whereas at MDS-2 1062 rmt retaining wall of 8 m height is proposed. In all total 56371 cum of retaining is proposed. In addition leveling of soil would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site.

All the approach roads to various project structures will be constructed by employing the methodology recommended by Border Roads with minimal environmental damage. The methodology consists in developing the formation width in half cutting and half filling, so that the materials obtained from cutting are utilized in filling. The excavation on hill side will be done to get a stable slope for the materials encountered. At places where there is problem of retaining the hill slope breast wall, gabion walls shall be done in natural slope to retain the fill materials.

In case of steep gorge, retaining wall, gabion structure shall be constructed to retain the fill material. To minimize the environmental damage, construction material like stones, sand,

Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

etc. required for the construction of road will be obtained mostly from the excavated material. In the streams, box culverts will be provided to prevent the erosion of nalla bed. In addition stone/concrete work on the downstream area will also be provided at vulnerable places to minimize erosion.

i) Retaining Walls

Total area for the dumping of muck is 36 ha which can accommodate about 48.2 lakh cum of muck whereas only 34.06 lakh cum muck is required to be disposed. Therefore sufficient spare capacity is available to accommodate extra muck in case of additional requirement. The total length of retaining wall proposed to be constructed along the river would be about 2202 running meters. The height of these retaining walls will be approximately 8m. The angle of repose would be around 30^0. These retaining walls are proposed to be located at a distance of more than 30.0m distance from the highest flood level/FRL. A typical sketch of the retaining wall is given in **Figure 7.4**. Total financial outlay for the retaining walls is **Rs.2958.00 lakhs**, given in **Table 7.4**.

Table 7. 4: Cost estimates for construction of retaining wall at the dumping sites

Height of the wall	8 m
Bottom width	5.4 m
Top width	1 m
Section area	25.6 m^2
Total length of protection walls	2202 m
Quantity of M15 concrete	56371.2 m^3
Average unit rate of M15 concrete including formwork	Rs. 5000 per m^3
Cost of concrete	Rs. 2818.00 lakhs
Add 5% for misc. items	Rs. 140.00 lakhs
Total cost of protection works	**Rs. 2958.00 lakhs**

ii) Compaction

Compaction is an engineering measure, which would reduce bulk density of the muck thereby optimising the use of muck disposal area and would make it suitable for the plantation and other biological measures. Top surface would be levelled and graded to make the alternative use. The muck will be spread in layers of 500-700mm thick layers. Top surface would be levelled and graded to make the alternative use. On top a layer of soil would be spread to make the land suitable for plantation. The total cost for the process of compaction is **Rs.1000.00 lakhs**

iii) Fencing

Fencing is a bio-engineering measure. After rehabilitation of muck the dumping areas need protection for some time from disturbing by human and domestic animals. For this reason fencing over the muck deposits is required. Barbed wire strands with two diagonal strands, clamped to wooden/ concrete posts placed at 3 m distance are proposed around the dumping piles. Project authorities will establish temporary wind barriers around 3 sides of dumps in close of settlement area. Total budget for the fencing would be **Rs.100.00 lakhs**.

7.5.2 Biological Measures

In order to stabilise the stacked dumped material vegetation cover would be provided which will hold the dumped material over a period of time. Following steps are envisaged.

Dr. G. S. S. H VARA PRASAD
Senior Manager (Environment)
NHPC Ltd

- Plantation of suitable tree species and soil binding using bio-fertilizer technology.
- Turfing of the exposed area and improvement of environment with ornamental species.
- Protection with mechanical support
- Social fencing through the mass public awareness.

The work plan formulated for re-vegetation of the dumping sites through 'Integrated Biotechnological Approach' is based on following parameters:

i) Evaluation of dumped material for their physical and chemical properties to assess the nutrient status to support vegetation.
ii) Formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.
iii) Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizers (biofertilizers inoculum) suitabile for the dumped material.
iv) Mass culture of plant specific biofertilizer and mycorrhizal fungi.
v) Plantation of dumping sites/areas using identified blend and biofertilizer inoculum.

The afforestation with suitable plant species of high ecological and economic value which can adapt to local habitat will be undertaken with 400-600 plants per hectare depending upon the canopy cover required. The list of suggested tree species which would be planted has already given earlier in the chapter.

Remedial measures would be carried out on an area of **36 ha**. The estimated cost of these measures would be **Rs.1070 lakh**. This cost includes the cost of turfing of slopes, preparation of ground, spreading of manure, etc., providing 5 cm of soil cover and transportation and carriage. It also includes the cost of fencing, irrigation, watch and ward, etc.

S. No.	Particulars	Quantity	Rate (in Rs.)	Amount (in Rs. Lakhs)
1	Rolling of Muck	Lump sum		150.00
2	Pitting (size: 0.45 m x 0.45 m x 0.45 m)	80,000 pits	100.00/pit	80.00
3	Raising of plants (including nursery cost, manure, transport etc.)	80,000 plants	50.00/plant	40.00
4	Maintenance, watering, transport, etc.	Lump sum		800.00
Total				**1070.00**

7.6 FINANCIAL REQUIREMENT

The estimated cost of the relocation and rehabilitation of excavated material is given in **Table 7.5**. The total cost of these measures will be **Rs. 5128.00 lakhs.**

Table 7. 5: Financial requirements for implementation of Muck Disposal Plan

S. No.	Item	Amount (Rs.in lakh)
1.	Engineering Measures	2958.00
2.	Compaction	1000.00
3	Fencing	100.00
4	Biological Measures	1070.00
	Total	**5128.00**

The detailed muck management plan will be finalized with the consultation of State Pollution Control Board and Forest Department, Jammu & Kashmir.

Dr. G.V.S. HYMAVATHI PRASAD
Senior Manager (Environment)
NHPC Ltd

Chapter 8 LANDSCAPING AND RESTORATION PLAN

8.1 INTRODUCTION

The proposed Sawalkote H.E. Project on River Chenab would require construction of various project components and infrastructural facilities like residential colonies for its staff, offices; contractor's and labour colonies in addition to various access roads and other structures.

During construction phase of the project, number of temporary construction sites and working areas will come up. In addition to this mining for construction material will also be carried out. To restore these areas to its original landscape as much as possible and retain its aesthetic values following restoration measures have been suggested. In addition avenue plantations around the colonies and working sites will be carried out.

8.2 LANDSCAPE DEGRADATION DUE TO PROJECT CONSTRUCTION ACTIVITIES

The proposed Sawalkote H. E. Project would involve construction of dam, diversion tunnels, intake, pressure shaft, Tail race tunnel (TRT), Power house, Adits, residential and staff colonies, roads, etc. These activities will result either in the modification or destruction of the existing landscape of the area. It is therefore imperative that after the project work and related activities are over restoration work should be carried out in these disturb areas to bring them back to their similar or near-similar pre-construction conditions and land use. Different project related activities will require acquisition of government as well as private land. The acquired land will also be used for dumping of muck and other garbage from the colony area. In addition to the habitat disturbance, project related activities will also result in the accumulation of large amounts of dumps at various construction sites, which needs to be either relocated or as an alternative can be utilized for landscaping. However, restoration success will largely depend on the topography of the area, the type of constructional activities and their detrimental effects on the terrain and the natural habitats.

There will be indirect disturbance to the area due to increase in human population and traffic movement. Construction activities like roads, muck dumping sites, quarry sites, colonies, workshops, offices, etc. which will change the existing land use/ land cover in the region. After completion of the construction work, it is required to restore the disturbed area to its original condition. Various engineering and biological measures have been suggested for the restoration of Sawalkote H.E. Project affected areas. Proposed mitigation measures will also help to arrest soil erosion in the region. Restoration of quarry sites, roads and colony area is discussed and a detailed plan is given for the landscaping of the region.

8.2.1 Proposed Access Roads

To execute the various civil works, roads would be built for linking the work sites to other sites and to job facility areas. They would essentially be unpaved and would be constructed at a workable gradient so that loaded construction equipment does not have to toil hard to go up