

## **Appendix**



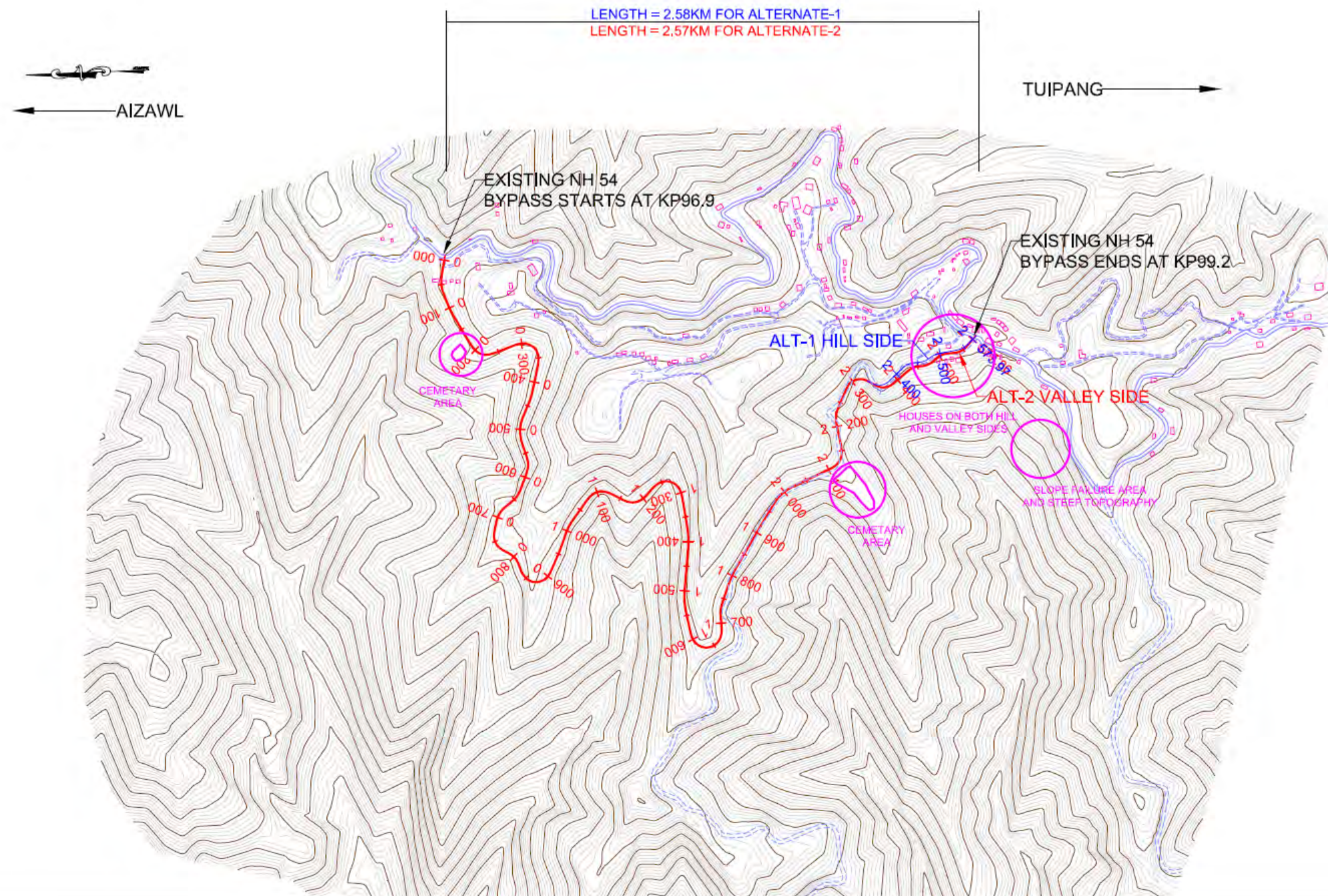
## Appendix-1-1: Alternative Routes for Chhiahtlang Bypass

### ALTERNATIVES FOR BYPASS-1, CHIATLANG BYPASS

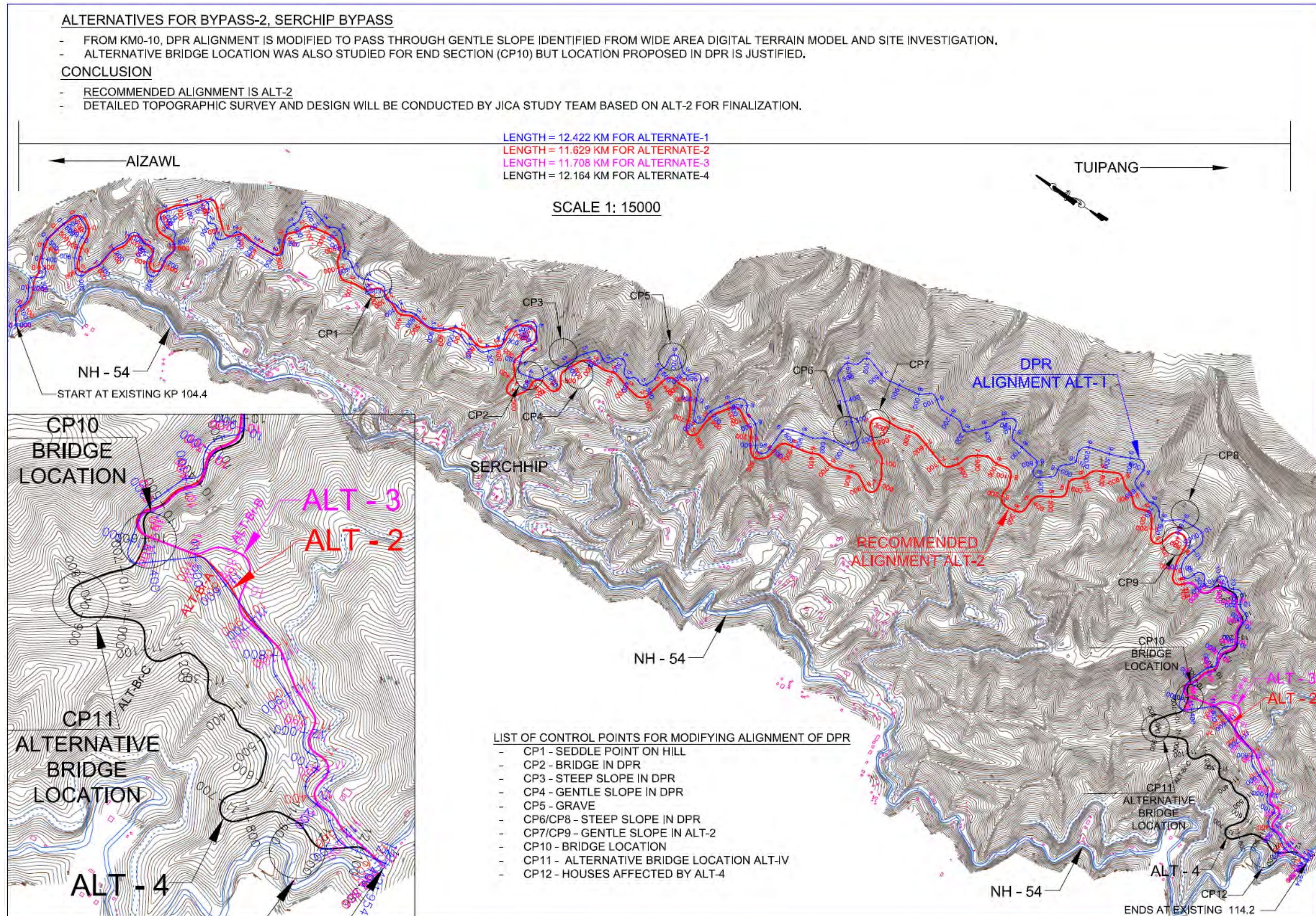
- BASICALLY THE ALIGNMENT IS SAME AS THAT OF DPR, BUT WITH MINOR MODIFICATION TO AVOID THE CEMETARY AREAS.
- THE END SECTION OF ABOUT 200M LENGTH PASSES THROUGH THE EXISTING ROAD WHERE HOUSES EXIST ON BOTH SIDES
- ALTERNATIVE-1 (ALT-1) PASSES THROUGH HILL SIDE IN THIS STRETCH TO AVOID THE HOUSES ON VALLEY SIDE
- ALTERNATIVE-2 (ALT-2) PASSES THROUGH VALLEY SIDE IN THIS STRETCH TO AVOID THE HOUSES ON HILL SIDE
- POSSIBILITY OF EXTENDING THE ENDING POINT TOWARDS SOUTH (TUIPANG SIDE) TO AVOID THESE HOUSES, BUT THERE EXIST A LARGE SLOPE FAILURE AREA JUST SOUTH OF THE ENDING POINT AND MANY HOUSES EXIST ALONG THE SLOPE

### CONCLUSION

- SINCE BOTH ALTERNATIVES ARE CLOSE TO EACH OTHER, DETAILED TOPOGRAPHIC SURVEY WILL BE CONDUCTED AND FINALIZED BY JICA STUDY TEAM



## Appendix-1-2: Alternative Routes for Serchhip Bypass



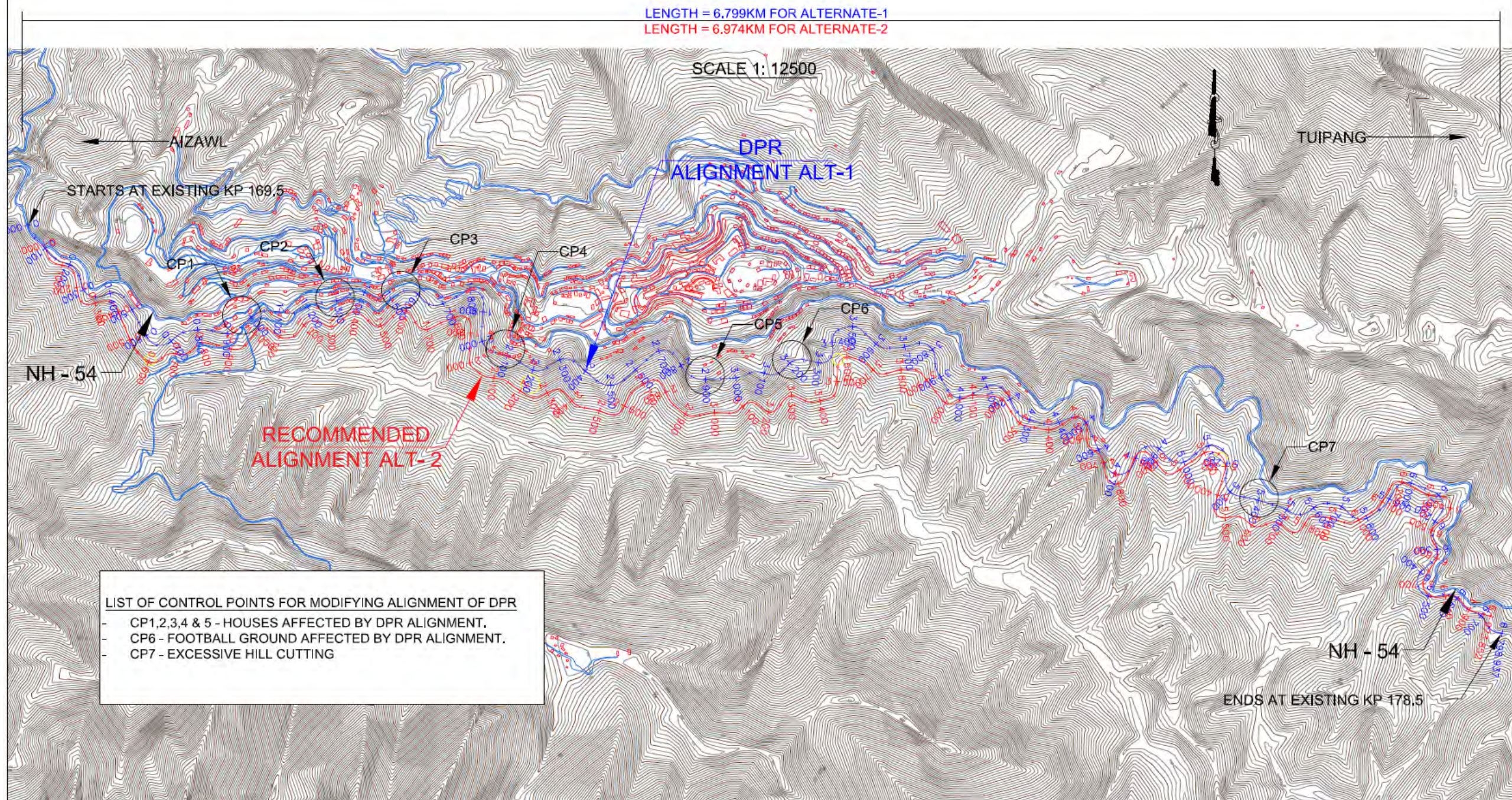
### Appendix-1-3: Alternative Routes for Hnahthial Bypass

#### ALTERNATIVES FOR BYPASS-3, HNATHIAL BYPASS

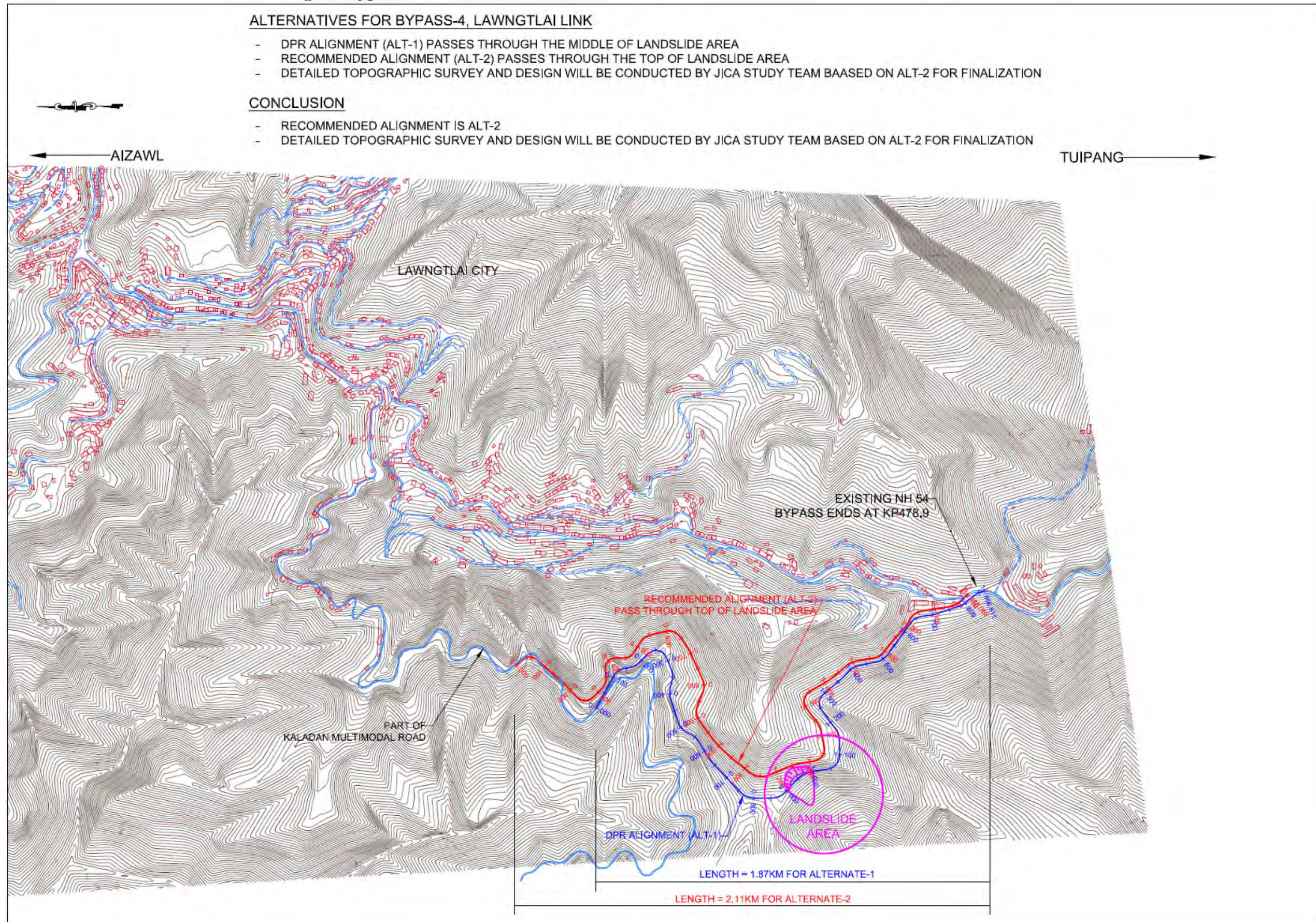
- DPR ALIGNMENT AFFECTED MANY HOUSES AND FOOTBALL GROUND

#### CONCLUSION

- RECOMMENDED ALIGNMENT IS ALT-2
- DETAILED TOPOGRAPHIC SURVEY AND DESIGN WILL BE CONDUCTED BY JICA STUDY TEAM BASED ON ALT-2 FOR FINALIZATION



### Appendix-1-4: Alternative Routes for Lawngtlai Bypass Link



## Appendix-2-1: Results of Alternative Analysis for Chhiahtlang Bypass

BP-1: Chhiahtlang Bypass

Route Name	Alternate-0	Alternate-1	Alternate-2
<b>Description</b>	- Improvement of NH-54	- Proposed route plan by DPR - Escape houses on valley side	- Escape houses on hill side
<b>Basic Condition</b>	- Route Length: L=2.2km - Starting Point: 90.100km from Aizawl - Ending Point: 92.300km from Aizawl	- Route Length: L=2.6km - Starting Point: 90.100km from Aizawl - Ending Point: 92.300km from Aizawl	- Route Length: L=2.6km - Starting Point: 90.100km from Aizawl - Ending Point: 92.300km from Aizawl
<b>Major Structure</b>	- Wet Masonry Retaining Wall: H=3.0m L=1,777m - Gravity Wall: H=4.0m L=444m	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=2,460m - Gravity Wall: H=1.5m~6.0m L=1,900m - Reinforced Earth Wall: H=10.0m L=40m - Bridge: L=30m (1 Nos.)	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=2,360m - Gravity Wall: H=1.5m~6.0m L=1,940m - Reinforced Earth Wall: H=8.0m~10.0m L=120m - Bridge: L=30m (1 Nos.)
<b>Running Safety</b>	[Horizontal Curve] - 20m ≤ R < 30m: 13 Nos. - 30m ≤ R < 40m: 12 Nos. - 40m ≤ R < 60m: 6 Nos. - 60m ≤ R : 7 Nos. [Vertical Gradient] - i < 3.0% : 1.9km - 3.0% ≤ i < 5.0%: 0.2km - 5.0% ≤ i < 7.0%: 0.6km - 7.0% ≤ i : 0.0km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 13 Nos. - 40m ≤ R < 60m: 10 Nos. - 60m ≤ R : 8 Nos. [Vertical Gradient] - i < 3.0% : 1.9km - 3.0% ≤ i < 5.0%: 0.1km - 5.0% ≤ i < 7.0%: 0.3km - 7.0% ≤ i : 0.3km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 13 Nos. - 40m ≤ R < 60m: 10 Nos. - 60m ≤ R : 8 Nos. [Vertical Gradient] - i < 3.0% : 1.9km - 3.0% ≤ i < 5.0%: 0.2km - 5.0% ≤ i < 7.0%: 0.3km - 7.0% ≤ i : 0.3km
<b>Environment Load</b>	- Distance with a national park: It is kept enough - Cultural assets: None - Common Property: There are water places and wells, but all are controlled		
<b>Spoil Bank</b>	Surplus Soil: V= 7,500m <sup>3</sup> Spoil Bank : V= 56,700m <sup>3</sup>	Surplus Soil: V=131,400m <sup>3</sup> Spoil Bank : V= 56,700m <sup>3</sup> Carrying Out: V= 74,700m <sup>3</sup>	Surplus Soil: V=118,100m <sup>3</sup> Spoil Bank : V= 56,700m <sup>3</sup> Carrying Out: V= 61,400m <sup>3</sup>
<b>Compensation</b>	Houses: 28 Nos.	Houses: 15 Nos.	Houses: 15 Nos.
<b>Cost Estimate</b>	Site Clearance 407,000 Rs Earthwork 6,723,000 Rs Pavement 98,175,000 Rs Drainage 21,909,000 Rs Bridge 0,000 Rs Slope Protection 51,304,000 Rs Traffic Safety Facilities 3,333,000 Rs <u>Road Appurtenances 3,850,000 Rs</u> Total 185,701,000 Rs	Site Clearance 481,000 Rs Earthwork 108,364,000 Rs Pavement 113,190,000 Rs Drainage 26,137,000 Rs Bridge 29,000,000 Rs Slope Protection 153,919,000 Rs Traffic Safety Facilities 3,939,000 Rs <u>Road Appurtenances 4,550,000 Rs</u> Total 439,580,000 Rs	Site Clearance 481,000 Rs Earthwork 101,035,000 Rs Pavement 113,505,000 Rs Drainage 25,960,000 Rs Bridge 29,000,000 Rs Slope Protection 173,279,000 Rs Traffic Safety Facilities 3,939,000 Rs <u>Road Appurtenances 4,550,000 Rs</u> Total 451,749,000 Rs
<b>Result</b>	Running Safety : 3rd Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 3rd Rank Cost Estimate : 1st Rank ✘Implementability of project is low, because there are many houses for compensation.	Running Safety : 1st Rank Environment Load: 1st Rank Spoil Bank : 3rd Rank Compensation : 1st Rank Cost Estimate : 2nd Rank	Running Safety : 1st Rank Environment Load: 1st Rank Spoil Bank : 2nd Rank Compensation : 1st Rank Cost Estimate : 3rd Rank
<b>Ranking</b>	<b>3</b>	<b>2</b>	<b>1</b>

## Appendix-2-2: Results of Alternative Analysis for Serchhip Bypass

BP-2: Serchhip Bypass

Route Name	Alternate-0	Alternate-1	Alternate-2	Alternate-3	Alternate-4
<b>Description</b>	- Improvement of NH-54	- Proposed route plan by DPR - Follow lower side of hill, but relatively steep, straight bridge alignment	- Follow upper side of hill which is relatively gentle, straight bridge alignment and smooth approach	- Follow upper side of hill which is relatively gentle, straight bridge alignment, but longer approach to reduce bridge length	- Follow upper side of hill which is relatively gentle, curve bridge alignment and winding approach
<b>Basic Condition</b>	- Route Length: L=9.7km - Starting Point: 97.280km from Aizawl - Ending Point: 106.580km from Aizawl	- Route Length: L=12.4km - Starting Point: 97.280km from Aizawl - Ending Point: 106.580km from Aizawl	- Route Length: L=11.6km - Starting Point: 97.280km from Aizawl - Ending Point: 106.580km from Aizawl	- Route Length: L=11.7km - Starting Point: 97.280km from Aizawl - Ending Point: 106.580km from Aizawl	- Route Length: L=12.2km - Starting Point: 97.280km from Aizawl - Ending Point: 106.580km from Aizawl
<b>Major Structure</b>	- Wet Masonry Retaining Wall: H=3.0m L=7,756m - Gravity Wall: H=4.0m L=1,939m	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=13,600m - Gravity Wall: H=1.5m~6.0m L=3,260m - Reinforced Earth Wall: H=7.0m~10.0m L=2,060m - Bridge: L=240m (2 Nos.)	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=11,034m - Gravity Wall: H=1.5m~6.0m L=6,460m - Reinforced Earth Wall: H=7.0m~10.0m L=440m - Bridge: L=210m (2 Nos.)	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=11,114m - Gravity Wall: H=1.5m~6.0m L=6,520m - Reinforced Earth Wall: H=7.0m~10.0m L=460m - Bridge: L=200m (2 Nos.)	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=11,532m - Gravity Wall: H=1.5m~6.0m L=6,680m - Reinforced Earth Wall: H=7.0m~10.0m L=820m - Bridge: L=150m (2 Nos.)
<b>Running Safety</b>	[Horizontal Curve] - 20m ≤ R < 30m: 3 Nos. - 30m ≤ R < 40m: 70 Nos. - 40m ≤ R < 60m: 20 Nos. - 60m ≤ R : 54 Nos. [Vertical Gradient] - i < 3.0% : 1.7km - 3.0% ≤ i < 5.0%: 2.9km - 5.0% ≤ i < 7.0%: 4.6km - 7.0% ≤ i : 0.3km	[Horizontal Curve] - 20m ≤ R < 30m: 69 Nos. - 30m ≤ R < 40m: 32 Nos. - 40m ≤ R < 60m: 21 Nos. - 60m ≤ R : 17 Nos. [Vertical Gradient] - i < 3.0% : 2.7km - 3.0% ≤ i < 5.0%: 5.4km - 5.0% ≤ i < 7.0%: 1.8km - 7.0% ≤ i : 2.5km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 48 Nos. - 40m ≤ R < 60m: 48 Nos. - 60m ≤ R : 40 Nos. [Vertical Gradient] - i < 3.0% : 1.5km - 3.0% ≤ i < 5.0%: 4.1km - 5.0% ≤ i < 7.0%: 2.8km - 7.0% ≤ i : 3.2km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 50 Nos. - 40m ≤ R < 60m: 50 Nos. - 60m ≤ R : 37 Nos. [Vertical Gradient] - i < 3.0% : 1.8km - 3.0% ≤ i < 5.0%: 3.9km - 5.0% ≤ i < 7.0%: 2.5km - 7.0% ≤ i : 3.5km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 56 Nos. - 40m ≤ R < 60m: 50 Nos. - 60m ≤ R : 37 Nos. [Vertical Gradient] - i < 3.0% : 1.5km - 3.0% ≤ i < 5.0%: 4.6km - 5.0% ≤ i < 7.0%: 2.9km - 7.0% ≤ i : 3.1km
<b>Environment Load</b>	- Distance with a national park: It is kepted enough - Cultural assets: None - Common Property: There are water places and wells, but all are controlled				
<b>Spoil Bank</b>	Surplus Soil: V= 32,900m <sup>3</sup> Spoil Bank : V=575,000m <sup>3</sup>	Surplus Soil: V=1,208,700m <sup>3</sup> Spoil Bank : V= 575,000m <sup>3</sup> Carrying Out: V= 633,700m <sup>3</sup>	Surplus Soil: V=566,500m <sup>3</sup> Spoil Bank : V=575,000m <sup>3</sup>	Surplus Soil: V=572,800m <sup>3</sup> Spoil Bank : V=575,000m <sup>3</sup>	Surplus Soil: V=565,900m <sup>3</sup> Spoil Bank : V=575,000m <sup>3</sup>
<b>Compensation</b>	Houses: 219 Nos.	Houses: 5 Nos.	Houses: 5 Nos.	Houses: 5 Nos.	Houses: 5 Nos.
<b>Cost Estimate</b>	Site Clearance 1,795,000 Rs Earthwork 29,345,000 Rs Pavement 428,610,000 Rs Drainage 83,060,000 Rs Bridge 0,000 Rs Slope Protection 224,025,000 Rs Traffic Safety Facilities 14,696,000 Rs <u>Road Appurtenances 16,975,000 Rs</u> Total 798,506,000 Rs	Site Clearance 2,294,000 Rs Earthwork 1,042,711,000 Rs Pavement 540,960,000 Rs Drainage 132,019,000 Rs Bridge 296,000,000 Rs Slope Protection 922,467,000 Rs Traffic Safety Facilities 18,786,000 Rs <u>Road Appurtenances 21,700,000 Rs</u> Total 2,976,937,000 Rs	Site Clearance 2,146,000 Rs Earthwork 501,729,000 Rs Pavement 508,620,000 Rs Drainage 123,867,000 Rs Bridge 278,000,000 Rs Slope Protection 630,466,000 Rs Traffic Safety Facilities 17,574,000 Rs <u>Road Appurtenances 20,300,000 Rs</u> Total 2,082,702,000 Rs	Site Clearance 2,165,000 Rs Earthwork 507,340,000 Rs Pavement 512,190,000 Rs Drainage 124,049,000 Rs Bridge 272,000,000 Rs Slope Protection 645,616,000 Rs Traffic Safety Facilities 17,726,000 Rs <u>Road Appurtenances 20,475,000 Rs</u> Total 2,101,561,000 Rs	Site Clearance 2,257,000 Rs Earthwork 516,513,000 Rs Pavement 532,560,000 Rs Drainage 134,322,000 Rs Bridge 129,000,000 Rs Slope Protection 734,858,000 Rs Traffic Safety Facilities 18,483,000 Rs <u>Road Appurtenances 21,350,000 Rs</u> Total 2,089,343,000 Rs
<b>Result</b>	Running Safety : 4th Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 5th Rank Cost Estimate : 1st Rank ※Implementability of project is low, because there are many houses for compensation.	Running Safety : 5th Rank Environment Load: 1st Rank Spoil Bank : 5th Rank Compensation : 1st Rank Cost Estimate : 5th Rank	Running Safety : 1st Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 1st Rank Cost Estimate : 2nd Rank	Running Safety : 2nd Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 1st Rank Cost Estimate : 4th Rank	Running Safety : 3rd Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 1st Rank Cost Estimate : 3rd Rank
<b>Ranking</b>	5	4	1	2	3



## Appendix-2-3: Results of Alternative Analysis for Hnahthial Bypass

BP-3: Hnahthial Bypass

Route Name	Alternate-0	Alternate-1	Alternate-2
<b>Description</b>	- Improvement of NH-54	- Proposed route plan by DPR - Follow upper side of hill but affects lots of houses	- Follow lower side of hill to avoid houses
<b>Basic Condition</b>	- Route Length: L=10.0km - Starting Point: 167.780km from Aizawl - Ending Point: 174.640km from Aizawl	- Route Length: L=6.8km - Starting Point: 167.780km from Aizawl - Ending Point: 174.640km from Aizawl	- Route Length: L=7.0km - Starting Point: 167.780km from Aizawl - Ending Point: 174.640km from Aizawl
<b>Major Structure</b>	- Wet Masonry Retaining Wall: H=3.0m L=8,000m - Gravity Wall: H=4.0m L=2,000m	- Wet Masonry Retaining Wall: H=3.0m L=6,479m - Gravity Wall: H=1.5m~6.0m L=1,710m - Reinforced Earth Wall: H=7.0m~10.0m L=940m - Bridge: L=100m (1 Nos.)	- Wet Masonry Retaining Wall: H=3.0m L=6,450m - Gravity Wall: H=1.5m~6.0m L=3,620m - Reinforced Earth Wall: H=7.0m~10.0m L=120m - Bridge: L=40m (1 Nos.)
<b>Running Safety</b>	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 48 Nos. - 40m ≤ R < 60m: 21 Nos. - 60m ≤ R : 21 Nos. [Vertical Gradient] - i < 3.0% : 2.1km - 3.0% ≤ i < 5.0%: 5.0km - 5.0% ≤ i < 7.0%: 0.5km - 7.0% ≤ i : 0.0km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 0 Nos. - 40m ≤ R < 60m: 45 Nos. - 60m ≤ R : 18 Nos. [Vertical Gradient] - i < 3.0% : 3.5km - 3.0% ≤ i < 5.0%: 0.3km - 5.0% ≤ i < 7.0%: 2.5km - 7.0% ≤ i : 0.5km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 36 Nos. - 40m ≤ R < 60m: 26 Nos. - 60m ≤ R : 9 Nos. [Vertical Gradient] - i < 3.0% : 3.5km - 3.0% ≤ i < 5.0%: 1.7km - 5.0% ≤ i < 7.0%: 1.8km - 7.0% ≤ i : 0.0km
<b>Environment Load</b>	- Distance with a national park: It is kepted enough - Cultural assets: None - Common Property: There are water places and wells, but all are controlled		
<b>Spoil Bank</b>	Surplus Soil: V= 33,900m <sup>3</sup> Spoil Bank : V=471,500m <sup>3</sup>	Surplus Soil: V=833,900m <sup>3</sup> Spoil Bank : V=471,500m <sup>3</sup> Carrying Out: V=362,400m <sup>3</sup>	Surplus Soil: V=248,900m <sup>3</sup> Spoil Bank : V=471,500m <sup>3</sup>
<b>Compensation</b>	Houses: 99 Nos.	Houses: 40 Nos.	Houses: 0 Nos.
<b>Cost Estimate</b>	Site Clearance 1,850,000 Rs Earthwork 30,268,000 Rs Pavement 442,050,000 Rs Drainage 26,200,000 Rs Bridge 0,000 Rs Slope Protection 231,070,000 Rs Traffic Safety Facilities 15,150,000 Rs Road Appurtenances 17,500,000 Rs Total 764,088,000 Rs	Site Clearance 1,258,000 Rs Earthwork 735,307,000 Rs Pavement 294,525,000 Rs Drainage 104,784,000 Rs Bridge 84,000,000 Rs Slope Protection 418,942,000 Rs Traffic Safety Facilities 10,302,000 Rs Road Appurtenances 11,900,000 Rs Total 1,661,018,000 Rs	Site Clearance 1,295,000 Rs Earthwork 218,167,000 Rs Pavement 304,185,000 Rs Drainage 107,265,000 Rs Bridge 33,000,000 Rs Slope Protection 296,929,000 Rs Traffic Safety Facilities 10,605,000 Rs Road Appurtenances 12,250,000 Rs Total 983,696,000 Rs
<b>Result</b>	Running Safety : 3rd Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 3rd Rank Cost Estimate : 1st Rank ※Implementability of project is low, because there are many houses for compensation.	Running Safety : 1st Rank Environment Load: 1st Rank Spoil Bank : 3rd Rank Compensation : 2nd Rank Cost Estimate : 3rd Rank	Running Safety : 2nd Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 1st Rank Cost Estimate : 2nd Rank
<b>Ranking</b>	<b>3</b>	<b>2</b>	<b>1</b>

## Appendix-2-4: Results of Alternative Analysis for Lawngtlai Bypass Link

BP-4: Lawngtlai Bypass

Route Name	Alternate-0	Alternate-1	Alternate-2
<b>Description</b>	- Improvement of NH-54	- Proposed route plan by DPR - Follow lower side of hill but passes through mid of landslide area	- Flow upper side of hill through upper side of landslide
<b>Basic Condition</b>	- Route Length: L=5.8km - Starting Point: 471.000km from Aizawl - Ending Point: 476.000km from Aizawl	- Route Length: L=6.3km(4.4km+1.9km) - Starting Point: 471.000km from Aizawl - Ending Point: 476.000km from Aizawl	- Route Length: L=6.1km(4.0km+2.1km) - Starting Point: 471.000km from Aizawl - Ending Point: 476.000km from Aizawl
<b>Major Structure</b>	- Wet Masonry Retaining Wall: H=3.0m L=4,656m - Gravity Wall: H=4.0m L=1,164m	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=1,710m - Gravity Wall: H=2.0m~6.0m L=1,467m	- Wet Masonry Retaining Wall: H=3.0m~7.0m L=1,950m - Gravity Wall: H=1.5m~6.0m L=1,630m - Reinforced Earth Wall: H=7.0m~10.0m L=140m
<b>Running Safety</b>	[Horizontal Curve] - 20m ≤ R < 30m: 5 Nos. - 30m ≤ R < 40m: 16 Nos. - 40m ≤ R < 60m: 10 Nos. - 60m ≤ R : 32 Nos. [Vertical Gradient] - i < 3.0% : 3.4km - 3.0% ≤ i < 5.0%: 0.5km - 5.0% ≤ i < 7.0%: 1.2km - 7.0% ≤ i : 0.0km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 24 Nos. - 40m ≤ R < 60m: 26 Nos. - 60m ≤ R : 13 Nos. [Vertical Gradient] - i < 3.0% : 1.6km - 3.0% ≤ i < 5.0%: 1.8km - 5.0% ≤ i < 7.0%: 2.8km - 7.0% ≤ i : 0.1km	[Horizontal Curve] - 20m ≤ R < 30m: 0 Nos. - 30m ≤ R < 40m: 29 Nos. - 40m ≤ R < 60m: 15 Nos. - 60m ≤ R : 18 Nos. [Vertical Gradient] - i < 3.0% : 1.6km - 3.0% ≤ i < 5.0%: 2.1km - 5.0% ≤ i < 7.0%: 2.3km - 7.0% ≤ i : 0.1km
<b>Environment Load</b>	- Distance with a national park: It is kepted enough - Cultural assets: None - Common Property: There are water places and wells, but all are controlled		
<b>Spoil Bank</b>	Surplus Soil: V= 19,700m <sup>3</sup> Spoil Bank : V=101,000m <sup>3</sup>	Surplus Soil: V=126,200m <sup>3</sup> Spoil Bank : V=101,000m <sup>3</sup> Carrying Out: V= 25,200m <sup>3</sup>	Surplus Soil: V=82,700m <sup>3</sup> Spoil Bank : V=101,000m <sup>3</sup>
<b>Compensation</b>	Houses: 112 Nos.	Houses: 3 Nos.	Houses: 0 Nos.
<b>Cost Estimate</b>	Site Clearance 1,073,000 Rs Earthwork 17,617,000 Rs Pavement 257,250,000 Rs Drainage 33,878,000 Rs Bridge 0,000 Rs Slope Protection 134,473,000 Rs Traffic Safety Facilities 8,787,000 Rs Road Appurtenances 10,150,000 Rs Total 463,228,000 Rs	Site Clearance 352,000 Rs Earthwork 106,705,000 Rs Pavement 82,215,000 Rs Drainage 28,065,000 Rs Bridge 0,000 Rs Slope Protection 126,109,000 Rs Landslide Control Work 71,790,000 Rs Traffic Safety Facilities 2,879,000 Rs Road Appurtenances 3,325,000 Rs Kaladan Multi Modal 440,000,000 Rs Total 861,440,000 Rs	Site Clearance 389,000 Rs Earthwork 73,137,000 Rs Pavement 92,715,000 Rs Drainage 32,442,000 Rs Bridge 0,000 Rs Slope Protection 167,485,000 Rs Landslide Control Work 46,680,000 Rs Traffic Safety Facilities 3,182,000 Rs Road Appurtenances 3,675,000 Rs Kaladan Multi Modal 400,000,000 Rs Total 819,705,000 Rs
<b>Result</b>	Running Safety : 3rd Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 3rd Rank Cost Estimate : 1st Rank ※Implementability of project is low, because there are many houses for compensation.	Running Safety : 2nd Rank Environment Load: 1st Rank Spoil Bank : 3rd Rank Compensation : 2nd Rank Cost Estimate : 3rd Rank	Running Safety : 1st Rank Environment Load: 1st Rank Spoil Bank : 1st Rank Compensation : 1st Rank Cost Estimate : 2nd Rank
<b>Ranking</b>	3	2	1

## Appendix-3: Slope Inventory Survey

### 1. SLOPE INVENTORY SURVEY AND GEOLOGICAL SURVEY RESULT

#### 1.1 Slope Inventory Survey Results

Planned bypass routes are covered by trees, therefore, the observation of outcrop near the planned routes is important for evaluation of slope stability by cutting.

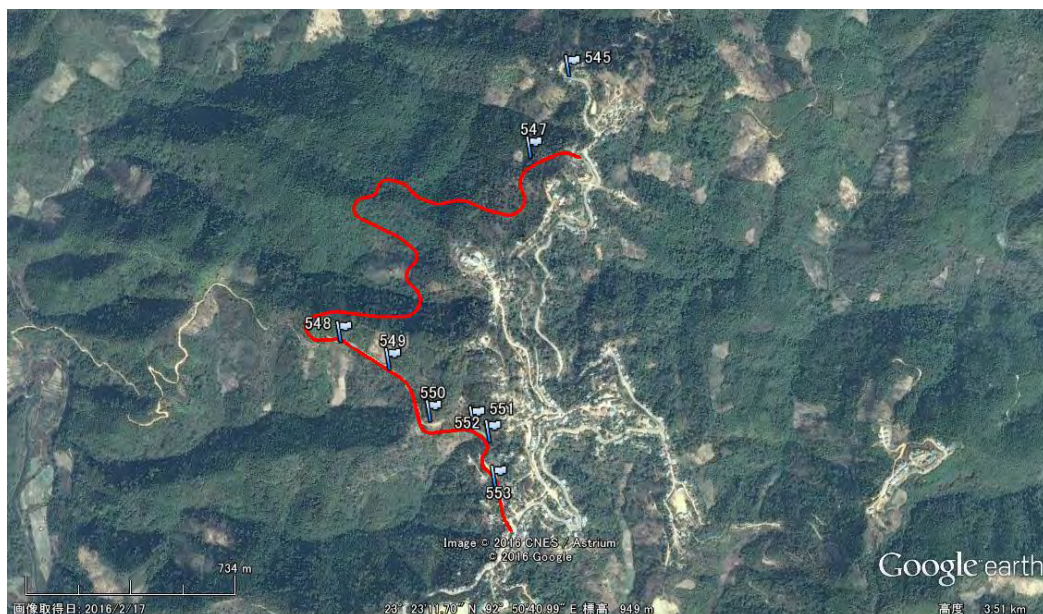
##### 1.1.1 Bypass No.1 (Chhiahtlang Area)

Table 1-1 and Figure 1-1 show the survey site locations while Table 1-2 shows the outcrop conditions. Each outcrop condition is shown in Figure 1-2.

Siltstone and sandstone are mainly distributed as bedrock in this area. Weathered condition of bedrock is strong to middle, so cracked rocks are observed along the cutting slope. Color of the rock is brownish due to weathering. As a whole, self-standing of the cutting slope is good. Therefore, the slope failure is hardly seen along the road. But if the height of cutting is high, there is a possibility of slope failure. On the other hand, a hard rock of sandstone was observed characteristically at the No.8 site.

**Table 1-1 Survey Site Locations**

Slope No.	Slope Condition	Location		
		GPS Log	Latitude	Longitude
1	Cutting Slope	545	N 23°23'33.76"	E 92°50'45.25"
2	Cutting Slope	547	N 23°23'26.17"	E 92°50'41.36"
3	Cutting Slope	548	N 23°23'9.02"	E 92°50'22.14"
4	Cutting Slope	549	N 23°23'6.52"	E 23°23'6.52"
5	Cutting Slope	550	N 23°23'1.73"	E 92°50'31.28"
6	Cutting Slope	551	N 23°23'1.21"	E 92°50'35.65"
7	Cutting Slope	552	N 23°22'59.95"	E 92°50'37.26"
8	Cutting Slope	553	N 23°22'55.75"	E 92°50'37.81"



Source: JICA Study Team: Red line is the planned bypass line

**Figure 1-1 Survey Site Locations**

**Table 1-2 Outcrop Conditions**

Slope No.	Location	Geology	Weathered Condition	Geotechnical Condition	Strike			Dip		Disaster Risk (due to slope cutting)
	GPS Log									
1	545	Muddy/Silty	Middle(Cracky)	Soft	N	75°	W	20°	N	Slope Failure
2	547	Muddy/Silty	Soil/Strong	Soft	—		—			Slope Failure
3	548	Silty Sand	Strong(cracky)	Soft	—		—			Slope Failure
4	549	Silty Sand	Middle(Cracky)	Soft	N	60°	E	50°	S	Slope Failure
5	550	Silty Sand	Middle(Cracky)	Soft	N	50°	W	55°	S	Slope Failure
6	551	Silty Sand	Middle(Cracky)	Hard	—		—			Slope Failure
7	552	Silty Sand	Fresh	Hard	N	15°	W	65°	S	Slope Failure
8	553	Siltstone/Sandstone	Strong and Weak	V. Hard and Soft	N	30°	E	42°	S	Slope Failure



No.1 Full View



No.1 Near View (cracky)



No.2 Full View



No.2 Near View



No.3 Full View



No.3 Near View



No.4 Full View



No.4 Near View



No.5 Full View



No.5 Near View



No.6 Full View



No.6 Near View



No.7 Full View



No.7 Near View



No.8 Full View



No.8 Near View (Sandstone: very hard rock)

**Figure 1-2 Outcrop Conditions**

### 1.1.2 Bypass No.2 (Serchhip Area)

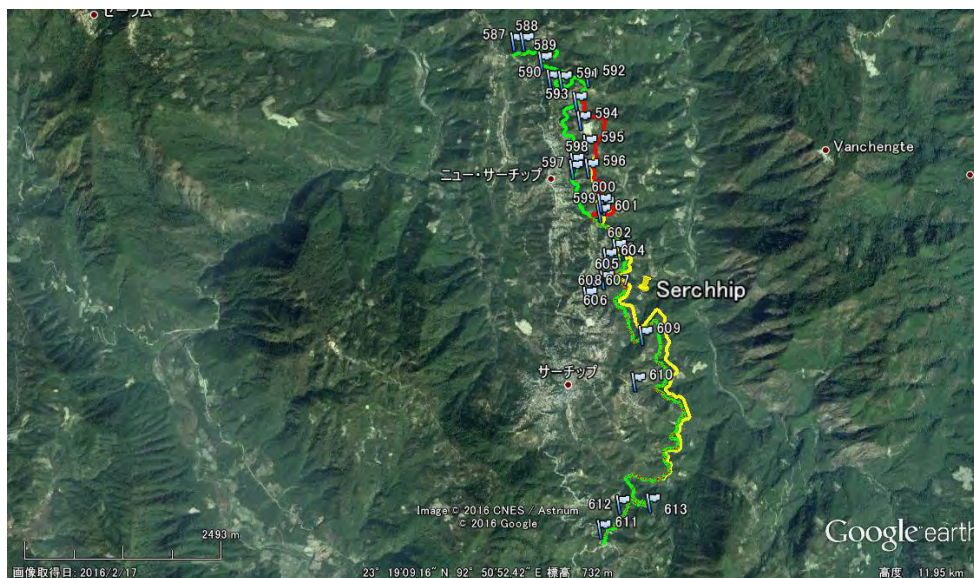
Table 1-3 and Figure 1-3 show the survey site locations while Table 1-4 shows the outcrop conditions. Each outcrop condition is shown in Figure 1-4.

Siltstone and sandstone are mainly distributed as bedrock in this area. Weathered condition of bedrock is mainly strong to middle, so cracked rocks are observed along the cutting slope. Also, the sediment with rock is observed in places. This sediment is judged from weathered rock at present location as mentioned below (refer to Chapter 2). Color of the rock is brownish due to weathering.

As a whole, self-standing of the cutting slope is good. But small slope failures are observed locally. On the other hand, the middle-weathered rocks are observed around the ridge as shown in No.6 to No.10. Probably, the strong weathered rocks on the middle-weathered rocks, which look like the sediment, are thought to have almost flowed out in the past. A part of the strong weathered rocks can be seen on the middle-weathered rocks in No.7 site. If the height of cutting is high, the weathered rocks have a possibility of slope failure.

Table 1-3 Survey Site Locations

Slope No.	Slope Condition	Location		
		GPS Log	Latitude	Longitude
1	Cutting Slope	587	N 23°20'51.80"	E 92°51'1.11"
2	Cutting Slope	588	N 23°20'51.63"	E 92°51'5.55"
3	Cutting Slope	589	N 23°20'43.16"	E 92°51'13.86"
4	Cutting Slope	590	N 23°20'35.24"	E 92°51'17.64"
5	Slope Failure/Cutting	591	N 23°20'34.63"	E 92°51'22.76"
6	Cutting Slope	592	N 23°20'36.16"	E 92°51'35.00"
7	Cutting Slope	593	N 23°20'25.92"	E 92°51'29.51"
8	Cutting Slope	594	N 23°20'17.87"	E 92°51'31.32"
9	Cutting Slope	595	N 23°20'7.99"	E 92°51'34.10"
10	Slope Failure/Cutting	596	N 23°19'58.11"	E 92°51'34.95"
11	Slope Failure/Cutting	599	N 23°19'42.85"	E 92°51'42.38"
12	Cutting Slope	600	N 23°19'43.88"	E 92°51'41.00"
13	Natural Slope	601	N 23°19'39.66"	E 92°51'40.65"
14	Slope Failure/Cutting	602	N 23°19'24.65"	E 92°51'47.93"
15	Cutting Slope	603	N 23°19'23.70"	E 92°51'50.98"
16	Cutting Slope	604	N 23°19'20.80"	E 92°51'43.28"
17	Cutting Slope	605	N 23°19'11.38"	E 92°51'41.90"
18	Cutting Slope	606	N 23°19'9.31"	E 92°51'36.63"
19	Slope Failure/Cutting	607	N 23°19'8.29"	E 92°51'36.08"
20	Cutting Slope	608	N 23°19'4.60"	E 92°51'34.07"
21	Natural Slope	609	N 23°18'48.18"	E 92°51'59.70"
22	Natural Slope	610	N 23°18'28.74"	E 92°51'56.22"
23	Cutting Slope	611	N 23°17'26.52"	E 92°51'40.92"
24	Cutting Slope	612	N 23°17'36.82"	E 92°51'49.62"
25	Cutting Slope	613	N 23°17'37.50"	E 92°52'3.54"



Red, yellow, and green lines are the planned bypass lines  
 Source: JICA Study Team










**Figure 1-3 Survey Site Locations**

**Table 1-4 Outcrop Conditions**





Slope No.	Location	Geology	Weathered Condition	Geotechnical Condition	Strike		Dip		Disaster Risk (due to slope cutting)	
	GPS Log									
1	587	Muddy/Silty	Middle(Cracky )	Soft	N	50°	E	10°	S	Slope Failure
2	588	Muddy/Silty	Middle	Soft	N	30°	W	60°	S	Slope Failure
3	589	Silty/Sandy	Middle	Soft	N	60°	E	45°	N	Slope Failure
4	590	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure
5	591	Silty/Sandy	Strong	Soft	N	18°	E	18°	S	Slope Failure(Exist)
6	592	Silty/Sandy	Soil/Middle	Soft	—	—	—	—	—	Slope Failure
7	593	Silty/Sandy	Strong	Soft	N	25°	E	38°	S	Slope Failure
8	594	Silty/Sandy	Middle	Soft	N	10°	E	40°	N	Slope Failure
9	595	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure
10	596	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure(Exist)
11	599	Silty/Sandy	Strong	Hard	N	10°	E	64°	S	Slope Failure(Exist)
12	600	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure
13	601	Sandy	Weak(Little cracky )	Soft/Hard	—	—	—	—	—	—
14	602	Silty/Sandy	Strong	Soft/Hard	—	—	—	—	—	Slope Failure(Exist)
15	603	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure
16	604	Silty/Sandy	Strong	Soft/Hard	—	—	—	—	—	Slope Failure
17	605	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure
18	606	Silty/Sandy	Strong	Soft	N	15°	W	63°	N	Slope Failure
19	607	Silty/Sandy	Strong	Hard	N	32°	W	74°	N	Slope Failure(Exist)
20	608	Silty/Sandy	Strong	Soft	N	25°	W	20°	N	Slope Failure
21	609	Silty/Sandy	Weak	Soft/Hard	—	—	—	—	—	—
22	610	Silty/Sandy	Soil/Weak	Soft	—	—	—	—	—	—
23	611	Silty/Sandy	Middle	Soft	—	—	—	—	—	Slope Failure
24	612	Silty/Sandy	Soil/Middle	Soft	—	—	—	—	—	Slope Failure
25	613	Silty/Sandy	Middle	Soft/Hard	—	—	—	—	—	Slope Failure



 <p>No.1 Full View</p>	 <p>No.1 Near View</p>
 <p>No.2 Full View</p>	 <p>No.2 Near View</p>
 <p>No.3 Full View</p>	 <p>No.3 Near View</p>
 <p>No.4 Full View</p>	 <p>No.4 Near View</p>
 <p>No.5 Full View</p>	 <p>No.5 Near View</p>

 <p>No.6 Full View</p>	 <p>No.6 Near View</p>
 <p>No.7 Full View</p>	 <p>No.7 Near View</p>
 <p>No.8 Full View</p>	 <p>No.8 Near View</p>
 <p>No.9 Full View</p>	 <p>No.9 Near View</p>
 <p>No.10 Full View</p>	 <p>No.10 Near View</p>

 <p>No.11 Full View</p>	 <p>No.11 Near View</p>
 <p>No.12 Full View</p>	 <p>No.12 Near View</p>
 <p>No.13 Full View</p>	 <p>No.13 Near View</p>
 <p>No.14 Full View</p>	 <p>No.14 Near View</p>
 <p>No.15 Full View</p>	 <p>No.15 Near View</p>

 <p>No.16 Full View</p>	 <p>No.16 Near View</p>
 <p>No.17 Full View</p>	 <p>No.17 Near View</p>
 <p>No.18 Full View</p>	 <p>No.18 Near View</p>
 <p>No.19 Full View</p>	 <p>No.19 Near View</p>
 <p>No.20 Full View</p>	 <p>No.20 Near View</p>



**Figure 1-4 Outcrop Conditions**

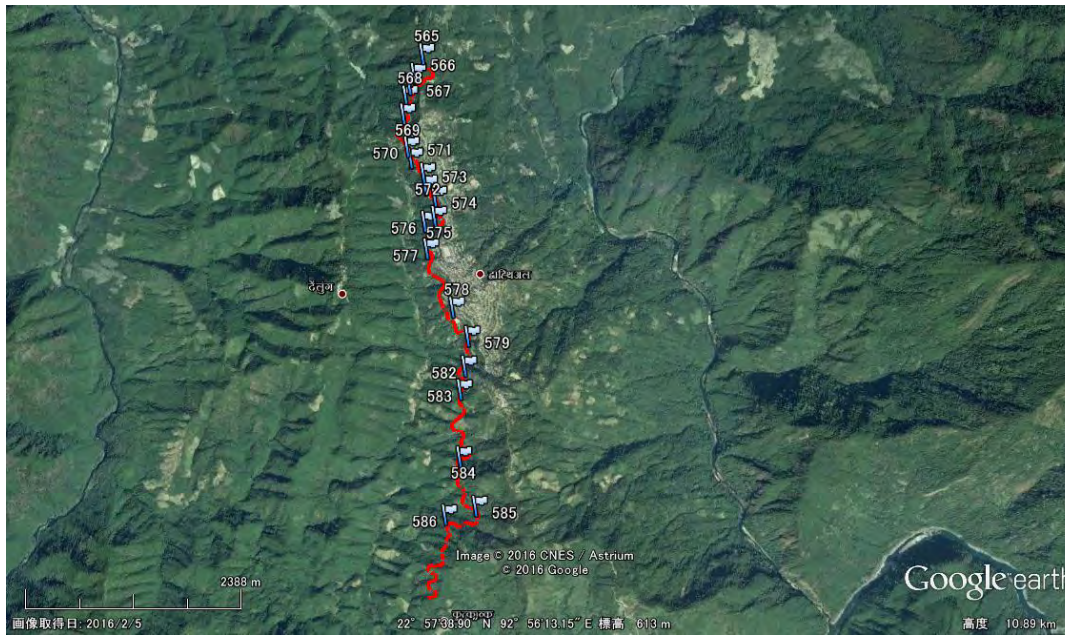
### 1.1.3 Bypass No.3 (Hnahthial Area)

Table 1-5 and Figure 1-5 show the survey site locations while Table 1-6 shows the outcrop conditions. Each outcrop condition is shown in Figure 1-6.

Siltstone and sandstone are mainly distributed as bedrock in this area. Weathered condition of bedrock is strong to middle, so cracked rocks are observed along the cutting slope. Also, the sediment with rock is observed in places. This sediment is judged from weathered rock at present location as mentioned below (refer to Chapter 2). Color of the rock is brownish due to weathering. As a whole, self-standing of the cutting slope is good. But as seen in No.4, No.5, No.8, No.9, No.13, No.16, and No.20, along the road, small slope failures are observed locally. Therefore, if the height of cutting is high, these weathered rocks have a possibility of slope failure.

**Table 1-5 Survey Site Locations**

Slope No.	Slope Condition	Location		
		GPS Log	Latitude	Longitude
1	Cutting Slope	565	N 22°59'8.51"	E 92°55'27.82"
2	Cutting Slope	566	N 22°59'1.75"	E 92°55'24.51"
3	Cutting Slope	567	N 22°58'57.82"	E 92°55'22.79"
4	Slope Failure/Cutting	568	N 22°58'53.79"	E 92°55'21.37"
5	Cutting Slope	569	N 22°58'47.34"	E 92°55'20.55"
6	Cutting Slope	570	N 22°58'35.95"	E 92°55'21.90"
7	Cutting Slope	571	N 22°58'32.07"	E 92°55'23.18"
8	Cutting Slope	572	N 22°58'26.67"	E 92°55'28.06"
9	Cutting Slope	573	N 22°58'22.44"	E 92°55'28.73"
10	Cutting Slope	574	N 22°58'18.43"	E 92°55'32.51"
11	Cutting Slope	575	N 22°58'11.27"	E 92°55'28.48"
12	Cutting Slope	576	N 22°58'9.60"	E 92°55'475"
13	Slope Failure/Cutting	577	N 22°57'59.91"	E 92°55'29.39"
14	Cutting Slope	578	N 22°57'39.30"	E 92°55'39.27"
15	Slope Failure/Cutting	579	N 22°57'29.15"	E 92°55'45.18"
16	Slope Failure/Cutting	582	N 22°57'18.53"	E 92°55'43.96"
17	Cutting Slope	583	N 22°57'10.24"	E 92°55'42.14"
18	Cutting Slope	584	N 22°56'46.35"	E 92°55'41.82"
19	Cutting Slope	585	N 22°56'28.70"	E 92°55'47.82"
20	Cutting Slope	586	N 22°56'25.18"	E 92°55'35.85"








Red line is the planned bypass line











**Figure 1-5 Survey Site Locations**











**Table 1-6 Outcrop Conditions**

Slope No.	Location	Geology	Weathered Condition	Geotechnical Condition	Strike			Dip		Disaster Risk (due to slope cutting)
	GPS Log									
1	565	Muddy/Silty	Middle	Soft	—	—	—	—	Slope Failure	
2	566	Muddy/Silty	Middle	Soft	—	—	—	—	Slope Failure	
3	567	Sandy	Soil/Middle	Soft	—	—	—	—	Slope Failure	
4	568	Silty/ Sandy	Strong	Soft	—	—	—	—	Slope Failure	
5	569	Muddy/Silty	Middle	Soft	—	—	—	—	Slope Failure	
6	570	Muddy/Silty	Middle	Soft	—	—	—	—	Slope Failure	
7	571	Muddy/Silty	Middle	Soft	—	—	—	—	Slope Failure	
8	572	Muddy/Silty	Soil/Strong	Soft	—	—	—	—	Slope Failure	
9	573	Muddy/Silty	Soil/Strong	Soft	—	—	—	—	Slope Failure	
10	574	Silty/ Sandy	Middle	Soft	—	—	—	—	Slope Failure	
11	575	Silty/ Sandy	Middle	Hard	N	10°	E	27°	S	Slope Failure
12	576	Silty/ Sandy	Soil/Middle	Soft	—	—	—	—	—	Slope Failure
13	577	Silty/ Sandy	Soil/Middle	Soft	—	—	—	—	—	Slope Failure(Exist)
14	578	Silty/ Sandy	Soil/Strong	Soft	N	30°	W	30°	S	Slope Failure
15	579	Silty/ Sandy	Strong	Soft	—	—	—	—	—	Slope Failure(Exist)
16	582	Silty/ Sandy	Soil/Middle	Soft	—	—	—	—	—	Slope Failure(Exist)
17	583	Silty/ Sandy	Soil/Middle	Soft/Hard	—	—	—	—	—	Slope Failure
18	584	Silty/ Sandy	Soil/Strong	Soft	—	—	—	—	—	Slope Failure
19	585	Silty/ Sandy	Strong	Soft/Hard	—	—	—	—	—	Slope Failure
20	586	Muddy/Silty	Strong	Soft	—	—	—	—	—	Slope Failure

	
<p>No.1 Full View</p>	<p>No.1 Near View</p>
	
<p>No.2 Full View</p>	<p>No.2 Near View</p>
	
<p>No.3 Full View</p>	<p>No.3 Near View</p>
	
<p>No.4 Full View</p>	<p>No.4 Near View</p>
	
<p>No.5 Full View</p>	<p>No.5 Near View</p>



	
<p>No.6 Full View</p>	<p>No.6 Near View</p>
	
<p>No.7 Full View</p>	<p>No.7 Near View</p>
	
<p>No.8 Full View</p>	<p>No.8 Near View</p>
	
<p>No.9 Full View</p>	<p>No.9 Near View</p>
	
<p>No.10 Full View</p>	<p>No.10 Near View</p>

	
<p>No.11 Full View</p>	<p>No.11 Near View</p>
	
<p>No.12 Full View</p>	<p>No.12 Near View</p>
	
<p>No.13 Full View</p>	<p>No.13 Near View</p>
	
<p>No.14 Full View</p>	<p>No.14 Near View</p>
	
<p>No.15 Full View</p>	<p>No.15 Near View</p>



**Figure 1-6 Outcrop Conditions**

#### 1.1.4 Bypass No.4 (Lawngtlai Area)

Table 1-7 and Figure 1-7 show the survey site locations while Table 1-8 shows the outcrop conditions. Each outcrop condition is shown in Figure 1-8.

This area has the geological characteristics which are different from those of the other three areas. The characteristics are as follows:

- Weathering condition of bedrock which got a lot of stress is significantly compared with other bypass areas. Therefore, this area has a condition of slope failure and landslide that easily occur.
- The active landslide which occurred by cutting was observed along the road (No.7). And this landslide has been moving at present.
- The brownish sediment which was formed by the slope failure in the past is distributed on the slope (No.10).

Actually, the sediment deposition which has a variation history is distributed on the slope along the Bypass No.4. This condition is obviously different from the other three areas (No.1-No.3).

Probably, the landslide of No.7 is thought to be the old one. Because, the disturbed outcrop is observed at the sliding cliff (refer to Chapter 3).

**Table 1-7 Survey Site Locations**

Slope No.	Slope Condition	Location		
		GPS Log	Latitude	Longitude
1	Slope Failure/Cutting	554	N 22°31'0.42"	E 92°53'14.15"
2	Slope Failure/Cutting	555	N 22°30'58.99"	E 92°53'7.94"
3	Slope Failure/Cutting	556	N 22°30'56.69"	E 92°53'5.04"
4	Slope Failure/Cutting	557	N 22°30'49.06"	E 92°53'0.56"
5	Cutting Slope	558	N 22°30'38.31"	E 92°53'1.32"
6	Cutting Slope	559	N 22°30'38.67"	E 92°53'5.11"
7	Landslide	563	N 22°30'38.94"	E 92°53'6.06"
8	Cutting Slope	560	N 22°30'38.75"	E 92°53'9.34"
9	Slope Failure/Cutting	561	N 22°30'38.03"	E 92°53'10.85"
10	Slope Failure/Cutting	562	N 22°30'32.85"	E 92°53'11.86"













Red line is the planned bypass line

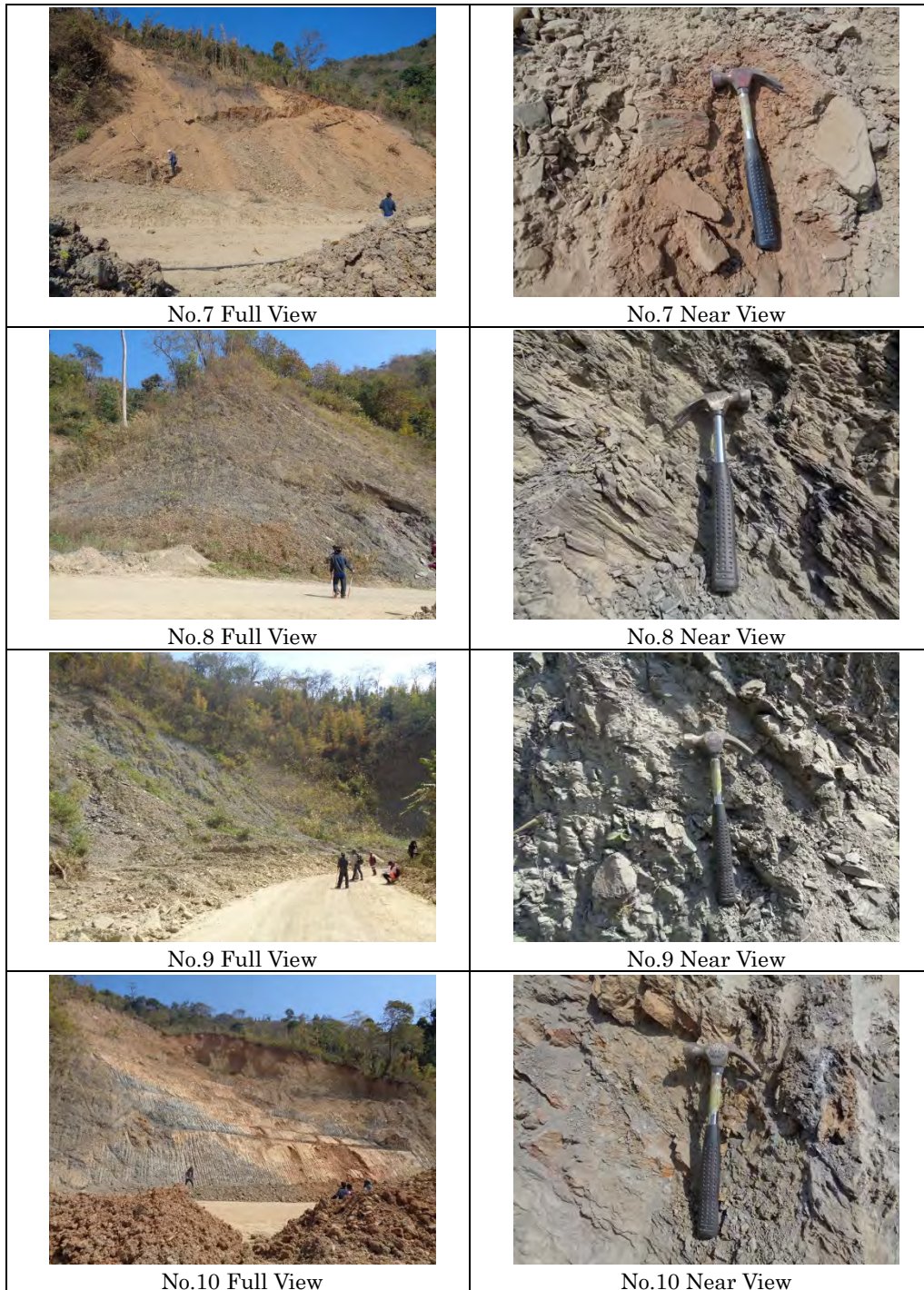
**Figure 1-7 Survey Site Locations**

**Table 1-8 Outcrop Conditions**

Slope No.	Location	Geology	Weathered Condition	Geotechnical Condition	Strike		Dip		Disaster Risk (due to slope cutting)	
	GPS Log									
1	554	Sandy	Strong/Fresh	Hard	N	30°	E	30°	S	Slope Failure(Exist)
2	555	Silty Sand	Strong/Fresh	Soft	—	—	—	—	—	Slope Failure(Exist)
3	556	Silty Sand	Strong/Fresh	Soft	—	—	—	—	—	Slope Failure(Exist)
4	557	Silty Sand	Strong	Soft	—	—	—	—	—	Slope Failure
5	558	Silty Sand	Strong	Soft	—	—	—	—	—	Slope Failure
6	559	Silty Sand	Strong	Soft	N	20°	W	48°	N	Slope Failure
7	563	Silty Sand	Strong	Soft	—	—	—	—	—	Landslide(Mass Movement)(Exist)
8	560	Silty Sand	Strong	Soft/Hard	N	25°	E	40°	N	Slope Failure
9	561	Silty Sand	Strong	Soft	—	—	—	—	—	Slope Failure(Exist)
10	562	Muddy/Sandy	Strong	Soft	—	—	—	—	—	Slope Failure(Exist)



	
<p>No.2 Full View</p>	<p>No.2 Near View</p>
	
<p>No.3 Full View</p>	<p>No.3 Near View</p>
	
<p>No.4 Full View</p>	<p>No.4 Near View</p>
	
<p>No.5 Full View</p>	<p>No.5 Near View</p>
	
<p>No.6 Full View</p>	<p>No.6 Near View</p>



**Figure 1-8 Outcrop Conditions**

## 2. GEOLOGICAL SURVEY RESULT

### 2.1 Boring Result

#### 2.1.1 Location of Boring Survey

Figure 2-1 shows the location of boring survey.

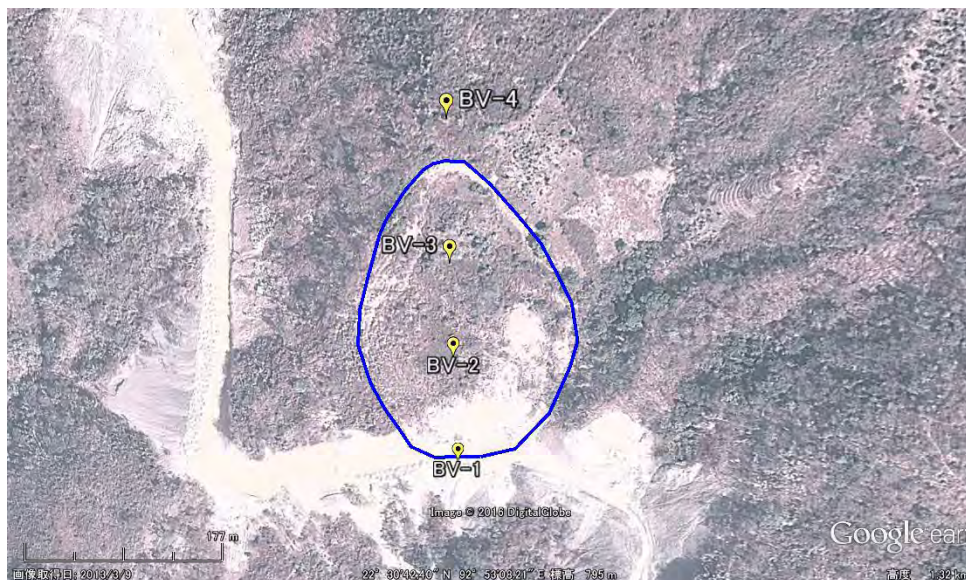


Figure 2-1 Location of Boring Survey

#### 2.1.2 Quantity of Boring Survey

Table 2-1 shows the quantities of boring survey.

**Table 2-1 Quantity of Boring Survey**

Boring No	Unit	Quantity
BV-1	m	15
BV-2	m	20
BV-2S	m	20
BV-3	m	20
BV-4	m	30
Total	m	105

#### 2.1.3 Survey Result

##### (1) BV-1

Geological condition is presumed as follows based on boring core. Probably, banking material is assumed to be distributed from 0.0 m to about 6.0 m. Natural ground is presumed to be distributed at about 6 m because grayish core was collected at the depth between 6 m and 8 m (Table 2-2, Figure 2-2).

**Table 2-2 Core Property (BV-1)**

Depth(m)			Geology	Remarks	Water Level (m)	Water Loss
0.0	-	6.0	Shale (Mudstone)	Weathered condition :Middle (Brownish color) Pebble shape: Banking material	5.5(07/03)	Partial
6.0	-	15.0	Shale (Mudstone)	Weathered condition :Middle (Brownish and grayish color) Pebble shape: Natural ground	8.7(08/03) 9.1(09/03)	Complete





**Figure 2-2 Core Photos (BV-1)**

**(2) BV-2**

Geological condition is presumed as follows based on boring core. Brownish sandstone was collected between 0.0 m and 12.0 m. Almost all boring cores are pebble shape but locally short stick shape. Natural ground is presumed to be distributed at about 17.0 m because grayish core was collected at the depth between 17.0 m and 20.0 m. Slip surface is presumed to be about 10 m in depth considering landslide scale (Table 2-3, Figure 2-3).

**Table 2-3 Core Property (BV-2)**

Depth(m)			Geology	Remarks	Water Level (m)	Water Loss
0.0	-	12.0	Sandstone	Weathered condition :Middle (Brownish color) Almost collected with pebble shape (locally short stick shape)	2.1(19/03) 4.2(20/03) 6.0(21/03)	Complete
12.0	-	20.0	Shale (Mudstone)	12.0-17.0 m: Brownish color Almost collected with pebble shape (locally short stick shape) 17.0-20.0 m: Grayish color Weathered condition :Weak Collected with pebble shape and short stick shape: Natural ground		



**Figure 2-3 Core Photos (BV-2)**

**(3) BV-2S (Groundwater Observation Hole)**

Geological condition is presumed as follows based on boring core. Brownish sandstone was collected between 0.0 m and 17.0 m. Almost all boring cores are pebble shape but locally short stick shape. Natural ground is presumed to be distributed at about 17.0 m because grayish core was collected at the depth between 17.0 m and 20.0 m. Slip surface is presumed to be about 10 m in depth considering landslide scale (Table 2-4, Figure 2-4).

**Table 2-4 Core Property (BV-2S)**

Depth(m)			Geology	Remarks	Water Level (m)	Water Loss
0.0	-	16.0	Sandstone	Weathered condition :Middle (Brownish color) Almost collected with pebble shape (locally short stick shape)	5.4 (23/03) 8.5 (24/03)	Complete
16.0	-	20.0	Shale (Mudstone)	Weathered condition :Weak (Grayish color) Collected with pebble shape and short stick shape: Natural ground		



**Figure 2-4 Core Photos (BV-2S)**

**(4) BV-3**

Geological condition is presumed as follows based on boring core. Brownish sandstone was collected between 0.0 m and 12.0 m. Almost all boring cores are pebble shape but locally short stick shape. Obvious natural ground is presumed to be distributed at about 19.0 m, because grayish core of short stick shape was collected at the depth between 19.0 m and 20.0 m. Slip surface is presumed to be between 10 m and 12 m in depth considering the topographical shape of landslide (Table 2-5, Figure 2-5).

**Table 2-5 Core Property (BV-3)**

Depth(m)			Geology	Remarks	Water Level (m)	Water Loss
0.0	-	10.0	Sandstone	Weathered condition :Middle (Brownish color) Almost collected with pebble shape (locally short stick shape)	5.3(07/04)	Complete
10.0	-	20.0	Shale (Mudstone)	Weathered condition :Middle (Brownish /Grayish color) Collected with pebble shape 10.0-12.0 m, 15.0-17.0 m: Brownish color 17.0-20.0 m: Grayish color	10.2(04/04)	



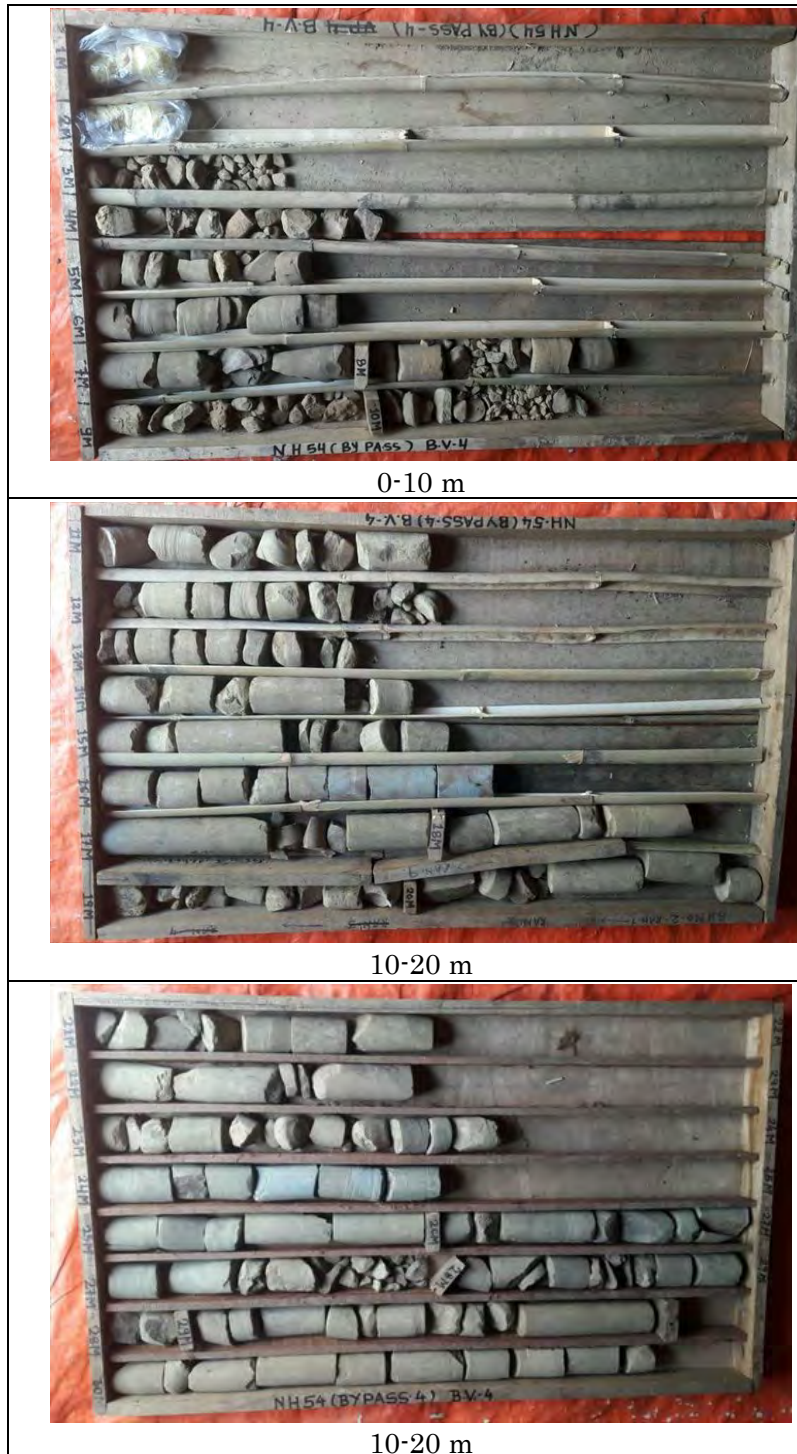
**Figure 2-5 Core Photos (BV-3)**

**(5) BV-4**

Geological condition is presumed as follows based on boring core. Grayish shale was collected between 2.0 m and 30.0 m excluding surface soil (0.0-2.0 m). Boring core between 2.0 m and 11.0 m is a bit crushed. Probably, this interval is presumed to be a looseness zone. Fresh rock core is collected below 11.0 m. Weathered condition is almost fresh rock. And the direction of crack is almost horizontal (Table 2-6, Table 2-5, Figure 2-6).

**Table 2-6 Core Property (BV-4)**

Depth(m)			Geology	Remarks	Water Level (m)	Water Loss
0.0	-	2.0	Sediment (Surface soil)	N-value 0-1 m: 8,13,33 1-2 m: 12,16,44		Complete
2.0	-	11.0	Shale (Mudstone)	Weathered condition :Weak /Fresh (Grayish color) Almost collected with pebble shape (locally short stick shape)	6.1(19/04)	
11.0	-	25.0	Shale (Mudstone)	Weathered condition :Fresh (Grayish color) Collected with short stick shape Crack direction: horizontal	11.8(20/04) 17.7(21/04)	
25.0	-	30.0	Shale (Mudstone) Partially (Sandstone)	Weathered condition :Fresh (Grayish color) Collected with short stick shape Crack direction: horizontal	18.7(22/04)	Partially



**Figure 2-6 Core Photos (BV-4)**

**(6) Assumed Landslide Profile**

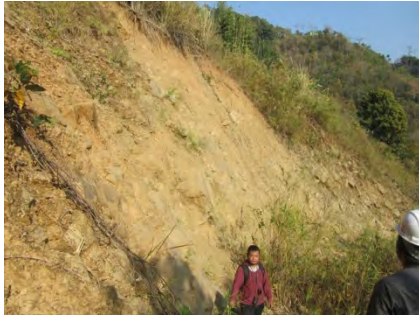
Location of the head and the lower end of landslide is judged as follows (see **Figure 2-7**):

i) Location of the Head of Landslide

Obvious sliding cliff is observed. So, the location of the head of the landslide is judged to be located at the lower end of the sliding cliff.

ii) Location of the Lower End of Landslide

The width of the landslide is about 80 m, so the thickness of landslide is presumed to be empirically about 10 m. There is no deformation on the road. Therefore, the location of the lower end of landslide is judged to be located at the lower end of the cutting slope of road.



Sliding Cliff



No Deformation on the Road

Figure 2-7 Head and Lower End of the Landslide

Figure 2-8 shows an assumed landslide profile studied based on the survey result above.

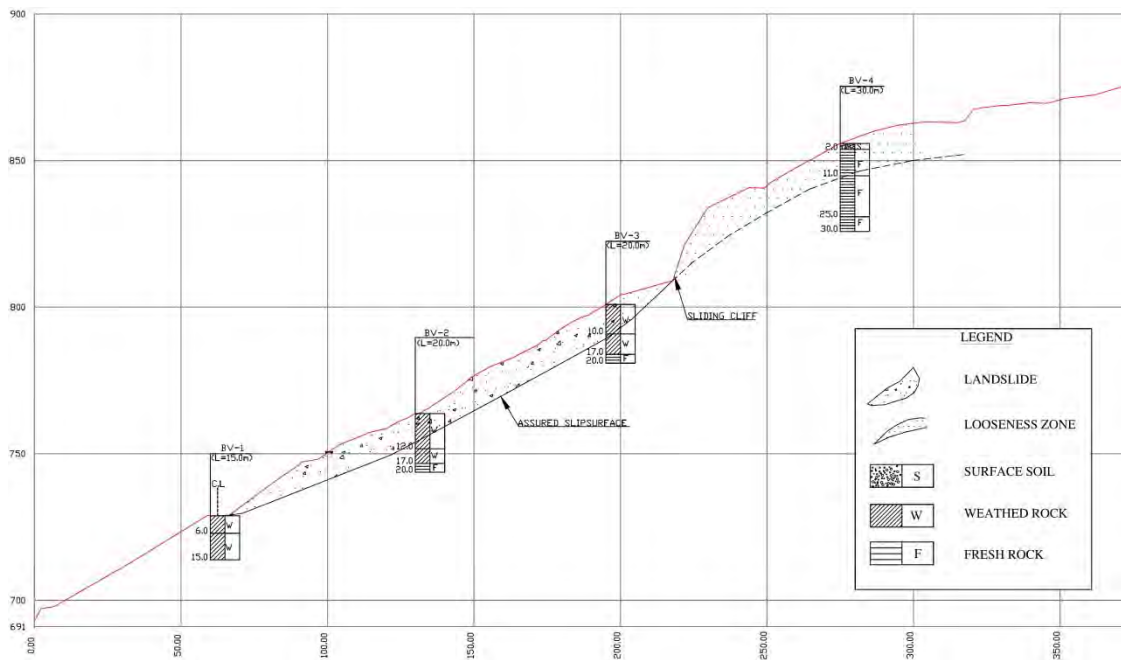


Figure 2-8 Assumed Landslide Profile

## Appendix-4: Cross Drainage List

Summary of cross-drainage numbers

	Bypass No.1	Bypass No.2	Bypass No.3	Bypass No.4
Pipe culvert 1.2m	19	78	40	13
(TYPE-A)	8	31	16	5
(TYPE-B)	11	47	24	8
BOX culvert 2x2m	1	8	12	6
BOX culvert 3x3m	0	2	5	0
BOX culvert 4x4m	0	3	0	0
Total	20	91	57	19

The pipe culvert typ for TYPE-A and TYPE-B is sepalated by the ratio of 0.4 : 0.6

TYPE-A : Straight section

TYPE-B : Curved section

### NH54BYPASS Cross-Drainage List (Bypass No.1)

Chainage (Project Alignment)	Additional Catchment Area (m2)	Discharge Qd (m3/s)	Proposed Structure	Drain Capacity (m3/s)
0+000	2,250	1.536	Pipe culvert dia 1.2m	4.17
0+125	1,360	1.463	Pipe culvert dia 1.2m	4.17
0+365	18,032	2.813	Pipe culvert dia 1.2m	4.17
0+455	14,065	2.503	Pipe culvert dia 1.2m	4.17
0+610	12,741	2.387	Pipe culvert dia 1.2m	4.17
0+715	1,734	1.494	Pipe culvert dia 1.2m	4.17
0+840	1,717	1.492	Pipe culvert dia 1.2m	4.17
1+020	6,582	1.883	Pipe culvert dia 1.2m	4.17
1+120	11,928	2.328	Pipe culvert dia 1.2m	4.17
1+280	41,975	4.706	Box culvert 2mx2m	15.88
1+365	9,710	2.139	Pipe culvert dia 1.2m	4.17
1+680	N/A	N/A	Pipe culvert dia 1.2m	4.17
1+800	4,109	1.685	Pipe culvert dia 1.2m	4.17
1+900	6,247	1.859	Pipe culvert dia 1.2m	4.17
1+960	11,202	2.265	Pipe culvert dia 1.2m	4.17
2+060	11,237	2.261	Pipe culvert dia 1.2m	4.17
2+205	19,413	2.925	Pipe culvert dia 1.2m	4.17
2+293	16,151	2.662	Pipe culvert dia 1.2m	4.17
2+400	2,860	1.586	Pipe culvert dia 1.2m	4.17
2+500	3,828	1.664	Pipe culvert dia 1.2m	4.17



**NH54BYPASS Cross-Drainage List (Bypass No.2)**

Chainage (Project Alignment)	Additional Catchment Area (m2)	Discharge Qd (m3/s)	Proposed Structure	Drain Capacity (m3/s)
0+000	110	1.36	Pipe culvert dia 1.2m	4.17
0+100	1,482	1.47	Pipe culvert dia 1.2m	4.17
0+200	542	1.40	Pipe culvert dia 1.2m	4.17
0+280	19,750	2.94	Pipe culvert dia 1.2m	4.17
0+360	8,274	2.03	Pipe culvert dia 1.2m	4.17
0+450	7,509	1.97	Pipe culvert dia 1.2m	4.17
0+520			Pipe culvert dia 1.2m	4.17
0+670	857	1.42	Pipe culvert dia 1.2m	4.17
0+860	553	1.40	Pipe culvert dia 1.2m	4.17
0+940	2,136	1.52	Pipe culvert dia 1.2m	4.17
1+060	3,422	1.63	Pipe culvert dia 1.2m	4.17
1+200	6,174	1.85	Pipe culvert dia 1.2m	4.17
1+310	736	1.41	Pipe culvert dia 1.2m	4.17
1+430	10,242	2.18	Pipe culvert dia 1.2m	4.17
1+580	5,113	1.77	Pipe culvert dia 1.2m	4.17
1+640	3,625	1.65	Pipe culvert dia 1.2m	4.17
1+690	1,112	1.44	Pipe culvert dia 1.2m	4.17
1+820	600	1.40	Pipe culvert dia 1.2m	4.17
2+140	5,381	1.79	Pipe culvert dia 1.2m	4.17
2+225	7,205	1.94	Pipe culvert dia 1.2m	4.17
2+360	5,406	1.79	Pipe culvert dia 1.2m	4.17
2+500	27,621	3.57	Pipe culvert dia 1.2m	4.17
2+655	4,312	1.70	Pipe culvert dia 1.2m	4.17
2+800	2,475	1.55	Pipe culvert dia 1.2m	4.17
2+970	6,473	1.87	Pipe culvert dia 1.2m	4.17
3+045	10,926	2.23	Pipe culvert dia 1.2m	4.17
3+180	9,562	2.12	Pipe culvert dia 1.2m	4.17
3+320	999	1.43	Pipe culvert dia 1.2m	4.17
3+435	1,160	1.45	Pipe culvert dia 1.2m	4.17
3+715	3,403	1.63	Pipe culvert dia 1.2m	4.17
3+860	10,226	2.17	Pipe culvert dia 1.2m	4.17
3+950	524	1.39	Pipe culvert dia 1.2m	4.17
4+100	1,261	1.46	Pipe culvert dia 1.2m	4.17
4+240	2,723	1.58	Pipe culvert dia 1.2m	4.17
4+370	3,290	1.62	Pipe culvert dia 1.2m	4.17
4+580	384,785	29.19	Box culvert 4mx4m	95.71
4+660	788	1.42	Pipe culvert dia 1.2m	4.17
4+800	75,937	7.20	Box culvert 2mx2m	15.88
4+950	5,206	1.78	Pipe culvert dia 1.2m	4.17
5+100	9,012	2.08	Pipe culvert dia 1.2m	4.17
5+340	40,228	4.57	Box culvert 2mx2m	15.88
5+450	2,738	1.58	Pipe culvert dia 1.2m	4.17
5+560	1,011	1.43	Pipe culvert dia 1.2m	4.17
5+670	5,254	1.78	Pipe culvert dia 1.2m	4.17
5+740	7,847	1.99	Pipe culvert dia 1.2m	4.17
5+860	114,968	10.37	Box culvert 2mx2m	15.88
5+940	7,154	1.94	Pipe culvert dia 1.2m	4.17
6+020	3,518	1.64	Pipe culvert dia 1.2m	4.17
6+180	7,687	1.98	Pipe culvert dia 1.2m	4.17
6+300	19,507	2.94	Pipe culvert dia 1.2m	4.17
6+380	168,303	14.44	Box culvert 3mx3m	36.19
6+440	42,277	4.71	Box culvert 2mx2m	15.88

### NH54BYPASS Cross-Drainage List (Bypass No.2)

Chainage (Project Alignment)	Additional Catchment Area (m2)	Discharge Qd (m3/s)	Proposed Structure	Drain Capacity (m3/s)
6+560	2,340	1.54	Pipe culvert dia 1.2m	4.17
6+680	14,113	2.50	Pipe culvert dia 1.2m	4.17
6+760	7,136	1.93	Pipe culvert dia 1.2m	4.17
6+800	18,822	2.87	Pipe culvert dia 1.2m	4.17
6+940	9,627	2.13	Pipe culvert dia 1.2m	4.17
7+040	405,915	30.53	Box culvert 4mx4m	95.71
7+110	9,728	2.15	Pipe culvert dia 1.2m	4.17
7+200	6,375	1.88	Pipe culvert dia 1.2m	4.17
7+320	1,899	1.51	Pipe culvert dia 1.2m	4.17
7+620	12,999	2.42	Pipe culvert dia 1.2m	4.17
7+760	17,462	2.77	Pipe culvert dia 1.2m	4.17
7+865	24,965	3.38	Pipe culvert dia 1.2m	4.17
7+910	13,072	2.42	Pipe culvert dia 1.2m	4.17
8+010	3,509	1.64	Pipe culvert dia 1.2m	4.17
8+120	11,163	2.25	Pipe culvert dia 1.2m	4.17
8+230	2,550	1.56	Pipe culvert dia 1.2m	4.17
8+370	124,273	11.15	Box culvert 3mx3m	36.19
8+475	40,113	4.58	Box culvert 2mx2m	15.88
8+600	45,154	4.99	Box culvert 2mx2m	15.88
8+840	4,188	1.69	Pipe culvert dia 1.2m	4.17
8+930	9,492	2.13	Pipe culvert dia 1.2m	4.17
9+080	5,563	1.80	Pipe culvert dia 1.2m	4.17
9+210	13,704	2.46	Pipe culvert dia 1.2m	4.17
9+330	1,667	1.49	Pipe culvert dia 1.2m	4.17
9+410	326,132	25.88	Box culvert 4mx4m	95.71
9+760	16,667	2.71	Pipe culvert dia 1.2m	4.17
9+830	13,140	2.41	Pipe culvert dia 1.2m	4.17
9+940	47,062	5.11	Box culvert 2mx2m	15.88
10+080	1,636	1.49	Pipe culvert dia 1.2m	4.17
10+200	1,495	1.47	Pipe culvert dia 1.2m	4.17
10+300	5,865	1.83	Pipe culvert dia 1.2m	4.17
10+460	21,066	3.08	Pipe culvert dia 1.2m	4.17
10+570	4,746	1.74	Pipe culvert dia 1.2m	4.17
10+660	18,130	2.83	Pipe culvert dia 1.2m	4.17
11+180	2,887	1.59	Pipe culvert dia 1.2m	4.17
11+300	17,523	2.78	Pipe culvert dia 1.2m	4.17
11+380	17,820	2.79	Pipe culvert dia 1.2m	4.17
11+490	35,862	4.24	Box culvert 2mx2m	15.88
11+680	2,983	1.60	Pipe culvert dia 1.2m	4.17

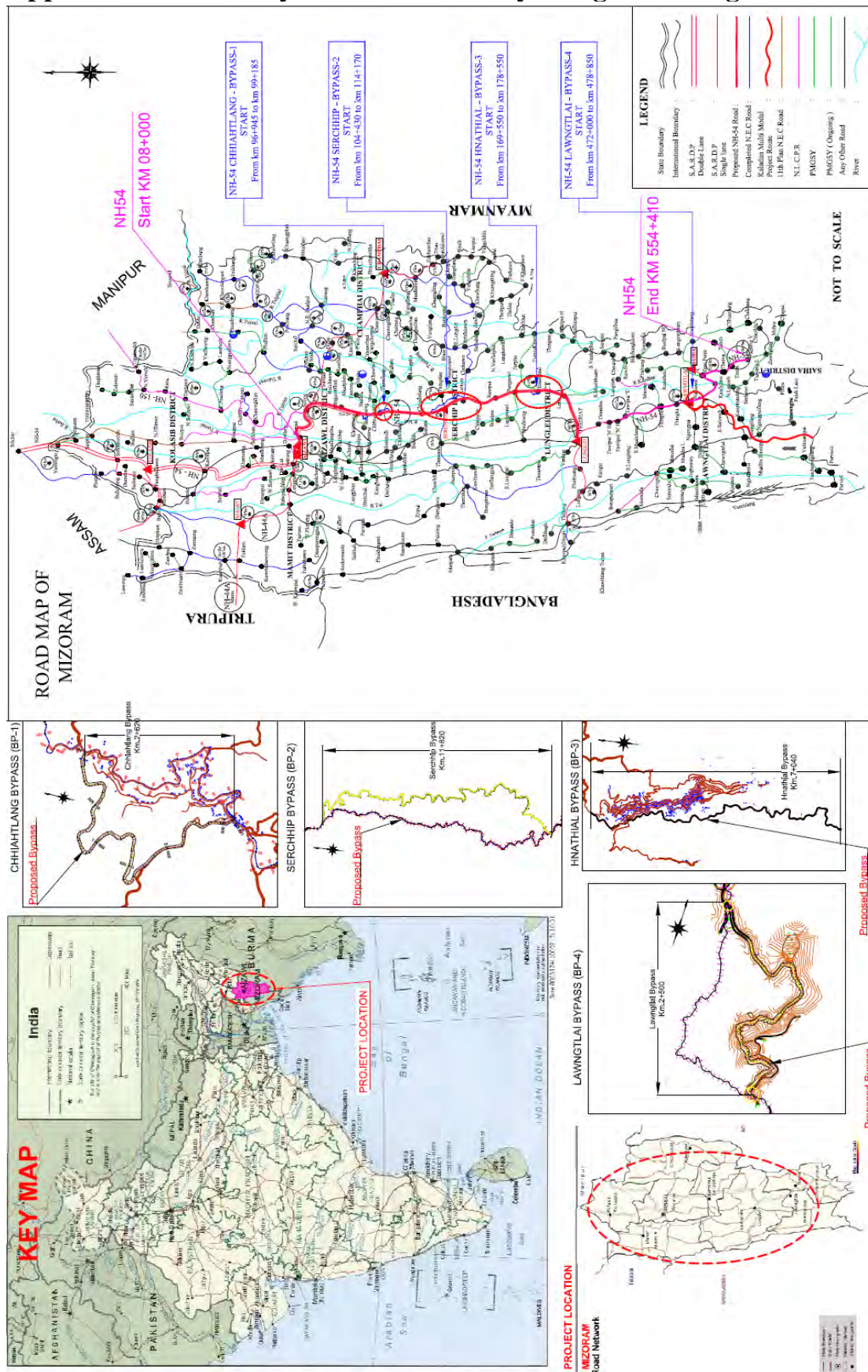
**NH54BYPASS Cross-Drainage List (Bypass No.3)**

Chainage (Project Alignment)	Additional Catchment Area (m2)	Discharge Qd (m3/s)	Proposed Structure	Drain Capacity (m3/s)
0+050	9,909	2.25	Pipe culvert dia 1.2m	4.17
0+140	12,640	2.50	Pipe culvert dia 1.2m	4.17
0+360	N/A	N/A	Pipe culvert dia 1.2m	4.17
0+420	45,242	5.38	Box culvert 2mx2m	15.88
0+500	2,741	1.60	Pipe culvert dia 1.2m	4.17
0+580	3,180	1.64	Pipe culvert dia 1.2m	4.17
0+690	21,407	3.27	Pipe culvert dia 1.2m	4.17
0+805	10,425	2.28	Pipe culvert dia 1.2m	4.17
0+900	12,744	2.49	Pipe culvert dia 1.2m	4.17
1+020	56,129	6.32	Box culvert 2mx2m	15.88
1+110	528	1.40	Pipe culvert dia 1.2m	4.17
1+230	26,893	3.76	Pipe culvert dia 1.2m	4.17
1+350	24,687	3.56	Pipe culvert dia 1.2m	4.17
1+590	25,104	3.61	Pipe culvert dia 1.2m	4.17
1+700	2,488	1.58	Pipe culvert dia 1.2m	4.17
1+830	42,631	5.16	Box culvert 2mx2m	15.88
1+930	8,857	2.16	Pipe culvert dia 1.2m	4.17
2+035	16,843	2.87	Pipe culvert dia 1.2m	4.17
2+155	11,801	2.42	Pipe culvert dia 1.2m	4.17
2+340	44,292	5.27	Box culvert 2mx2m	15.88
2+480	10,797	2.33	Pipe culvert dia 1.2m	4.17
2+640	24,229	3.54	Pipe culvert dia 1.2m	4.17
2+740	75,719	8.10	Box culvert 2mx2m	15.88
2+840	1,451	1.48	Pipe culvert dia 1.2m	4.17
3+020	20,174	3.15	Pipe culvert dia 1.2m	4.17
3+125	49,988	5.78	Box culvert 2mx2m	15.88
3+290	27,761	3.82	Pipe culvert dia 1.2m	4.17
3+370	1,753	1.51	Pipe culvert dia 1.2m	4.17
3+540	35,038	4.46	Box culvert 2mx2m	15.88
3+640	75,906	8.07	Box culvert 2mx2m	15.88
3+820	58,008	6.49	Box culvert 2mx2m	15.88
3+940	3,231	1.65	Pipe culvert dia 1.2m	4.17
4+100	13,393	2.56	Pipe culvert dia 1.2m	4.17
4+140	29,117	3.96	Pipe culvert dia 1.2m	4.17
4+190	17,191	2.90	Pipe culvert dia 1.2m	4.17
4+300	2,281	1.56	Pipe culvert dia 1.2m	4.17
4+490	93,072	9.59	Box culvert 3mx3m	36.19
4+680	1,000	1.44	Pipe culvert dia 1.2m	4.17
4+800	4,594	1.77	Pipe culvert dia 1.2m	4.17
4+905	42,283	5.13	Box culvert 2mx2m	15.88
5+090	7,016	1.99	Pipe culvert dia 1.2m	4.17
5+180	147,775	14.14	Box culvert 3mx3m	36.19
5+220	118,156	11.67	Box culvert 3mx3m	36.19
5+320	11,466	2.39	Pipe culvert dia 1.2m	4.17
5+520	11,698	2.40	Pipe culvert dia 1.2m	4.17
5+630	8,295	2.10	Pipe culvert dia 1.2m	4.17
5+790	14,863	2.70	Pipe culvert dia 1.2m	4.17
5+880	25,135	3.61	Pipe culvert dia 1.2m	4.17
6+000	5,979	1.89	Pipe culvert dia 1.2m	4.17
6+160	153,784	14.51	Box culvert 3mx3m	36.19
6+220	69,882	7.54	Box culvert 2mx2m	15.88
6+330	104,991	10.60	Box culvert 3mx3m	36.19
6+350	33,941	4.36	Box culvert 2mx2m	15.88
6+550	10,223	2.27	Pipe culvert dia 1.2m	4.17
6+620	2,373	1.57	Pipe culvert dia 1.2m	4.17
6+820	19,616	3.12	Pipe culvert dia 1.2m	4.17
6+920	23,054	3.42	Pipe culvert dia 1.2m	4.17

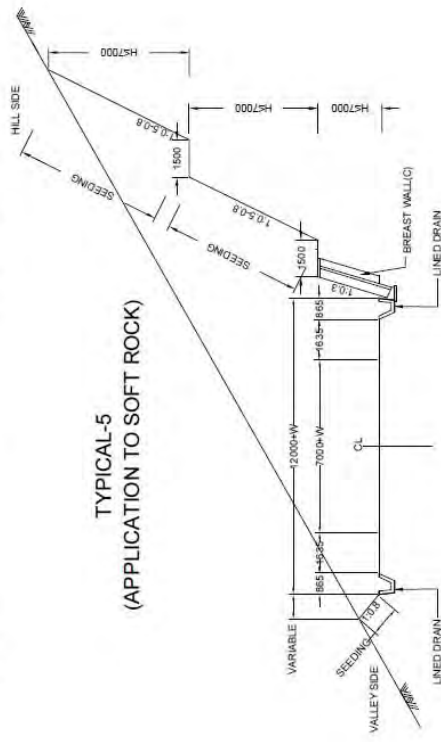
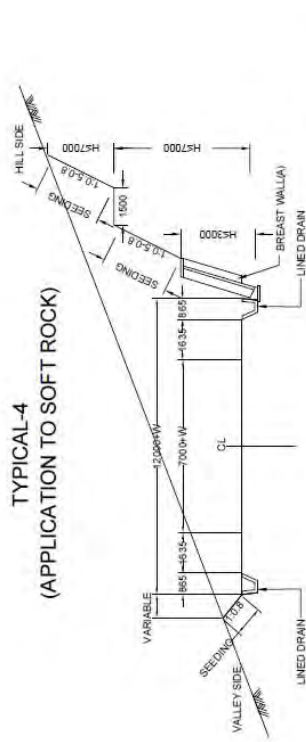
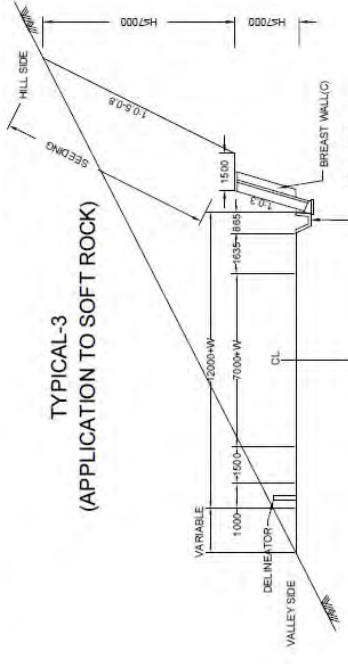
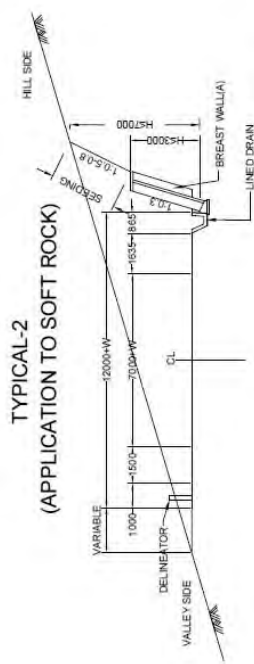
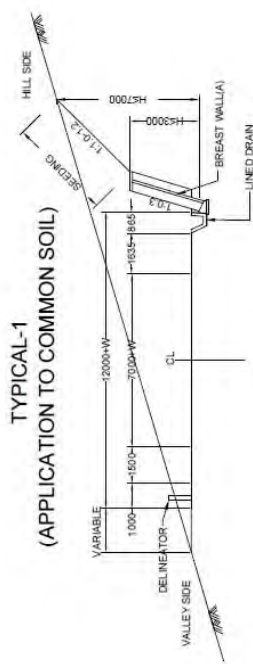
**NH54BYPASS Cross-Drainage List (Bypass No.4)**

Chainage (Project Alignment)	Additional Catchment Area (m2)	Discharge Qd (m3/s)	Proposed Structure	Drain Capacity (m3/s)
0+060	9,296	2.28	Pipe culvert dia 1.2m	4.17
0+170	31,591	4.02	Box culvert 2mx2m	15.88
0+320	14,316	2.58	Pipe culvert dia 1.2m	4.17
0+480	47,121	5.53	Box culvert 2mx2m	15.88
0+560	7,804	2.07	Pipe culvert dia 1.2m	4.17
0+720	807	1.42	Pipe culvert dia 1.2m	4.17
0+850	36,572	4.65	Box culvert 2mx2m	15.88
0+965	15,003	2.70	Pipe culvert dia 1.2m	4.17
1+045	19,841	3.14	Box culvert 2mx2m	15.88
1+115	19,093	3.07	Pipe culvert dia 1.2m	4.17
1+240	24,751	3.58	Box culvert 2mx2m	15.88
1+400	6,786	1.97	Pipe culvert dia 1.2m	4.17
1+520	8,712	2.14	Pipe culvert dia 1.2m	4.17
1+620	3,245	1.65	Pipe culvert dia 1.2m	4.17
1+980	23,142	3.42	Box culvert 2mx2m	15.88
2+080	16,395	2.84	Pipe culvert dia 1.2m	4.17
2+160	18,379	3.01	Pipe culvert dia 1.2m	4.17
2+320	8,235	2.10	Pipe culvert dia 1.2m	4.17
2+440	6,224	1.92	Pipe culvert dia 1.2m	4.17

# Appendix-5: Summary of the Preliminary Design Drawings



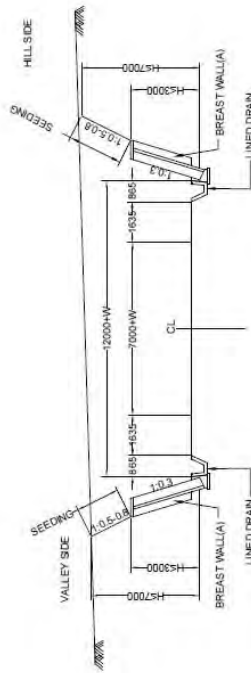
TYPICAL CROSS SECTION(1/6)  
FORMATION IN CUTTING  
SCALE 1:200



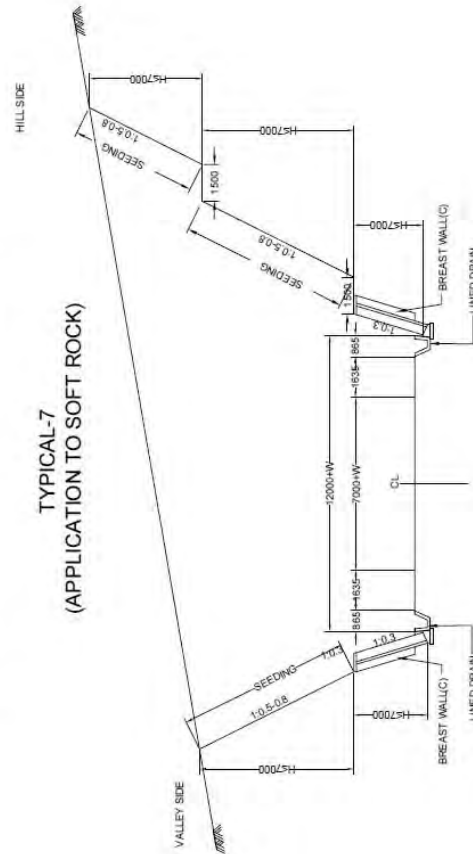
NOTE : SEEDING ONLY ON 1:0.8 SLOPE

TYPICAL CROSS SECTION (2/6)  
FORMATION IN CUTTING  
SCALE 1:200

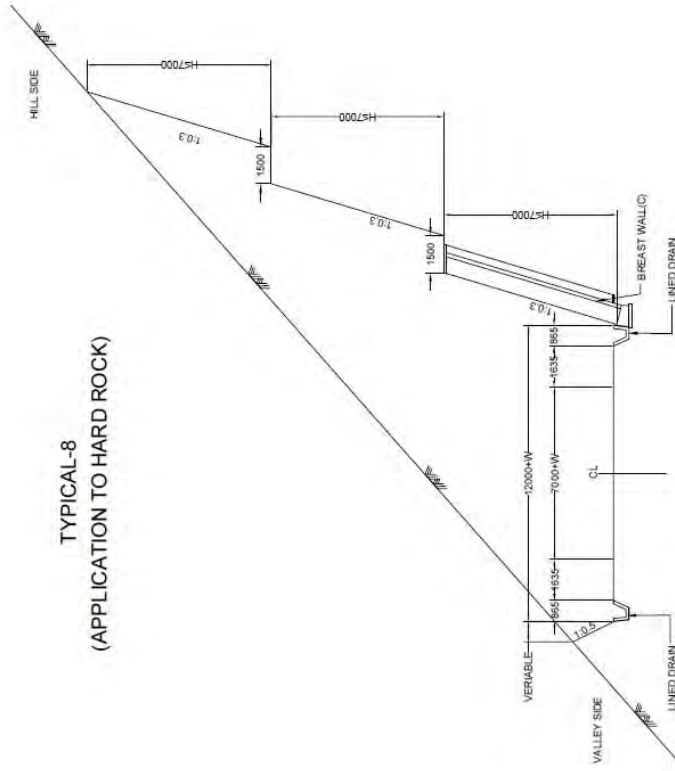
TYPICAL-6  
(APPLICATION TO SOFT ROCK)



TYPICAL-7  
(APPLICATION TO SOFT ROCK)



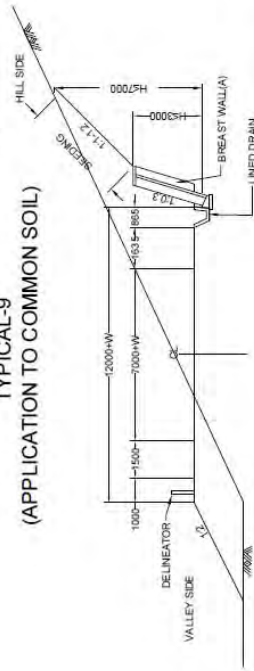
TYPICAL-8  
(APPLICATION TO HARD ROCK)



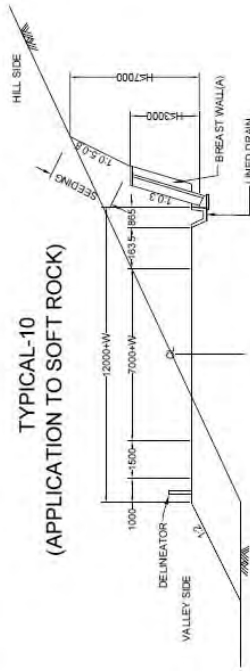
NOTE : SEEDING ONLY ON 1:0.8 SLOPE

TYPICAL CROSS SECTION (3/6)  
FORMATION IN CUTTING AND EMBANKMENT  
SCALE 1:200

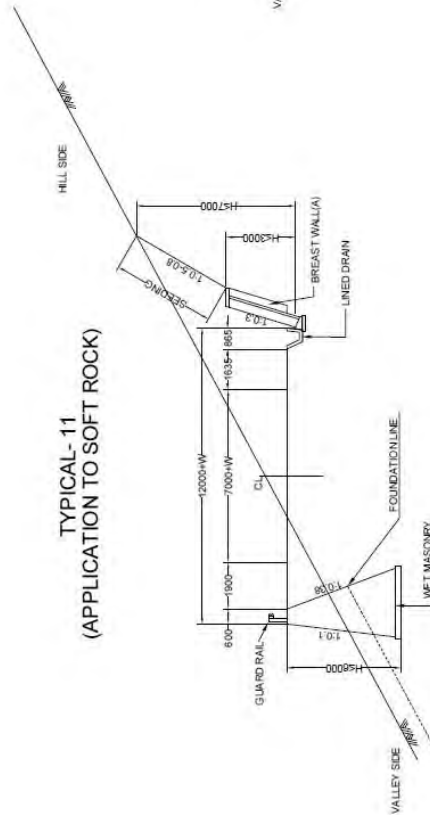
TYPICAL-9  
(APPLICATION TO COMMON SOIL)



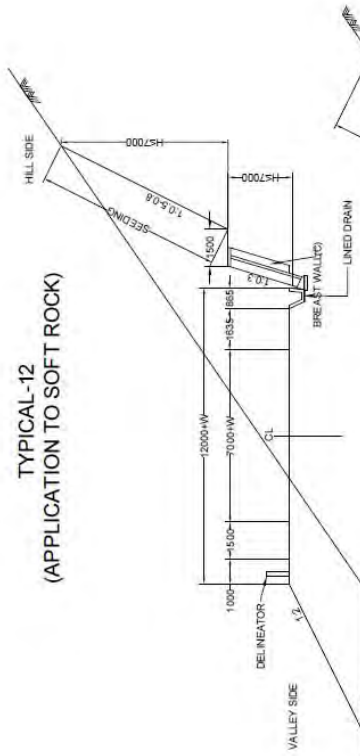
TYPICAL-10  
(APPLICATION TO SOFT ROCK)



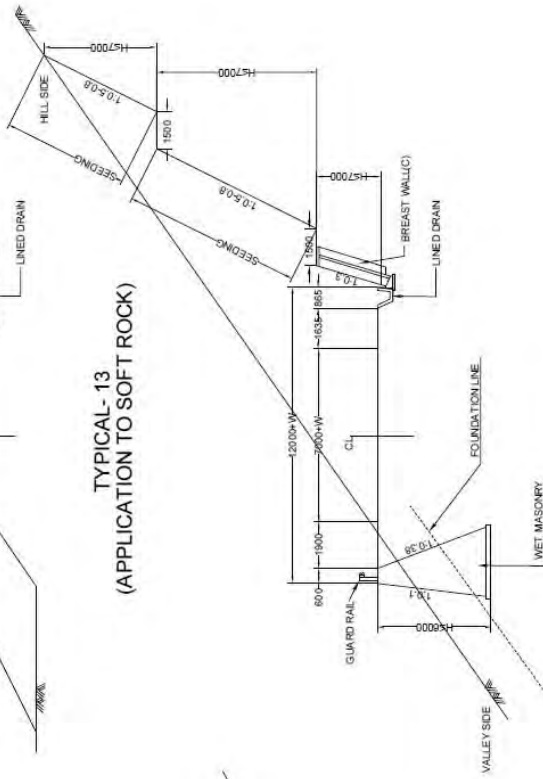
TYPICAL-11  
(APPLICATION TO SOFT ROCK)



TYPICAL-12  
(APPLICATION TO SOFT ROCK)



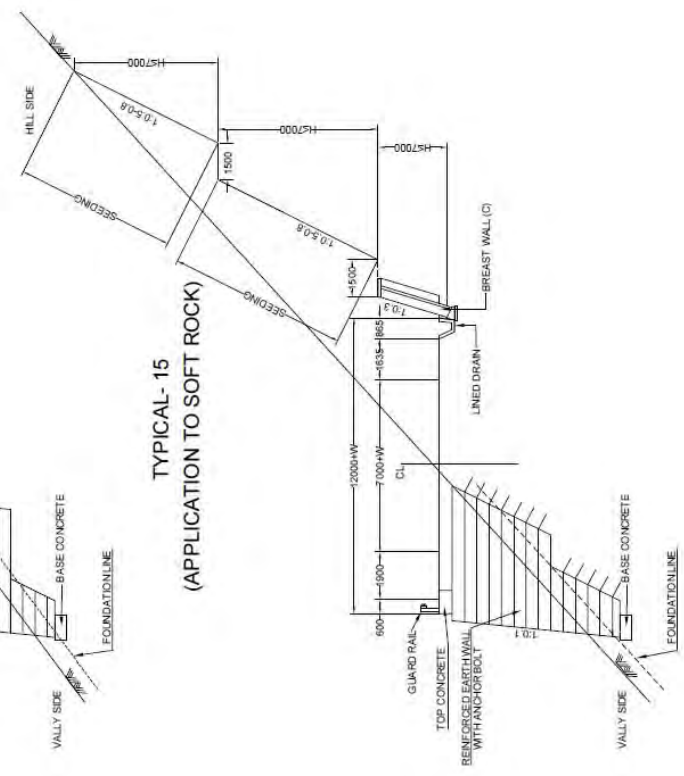
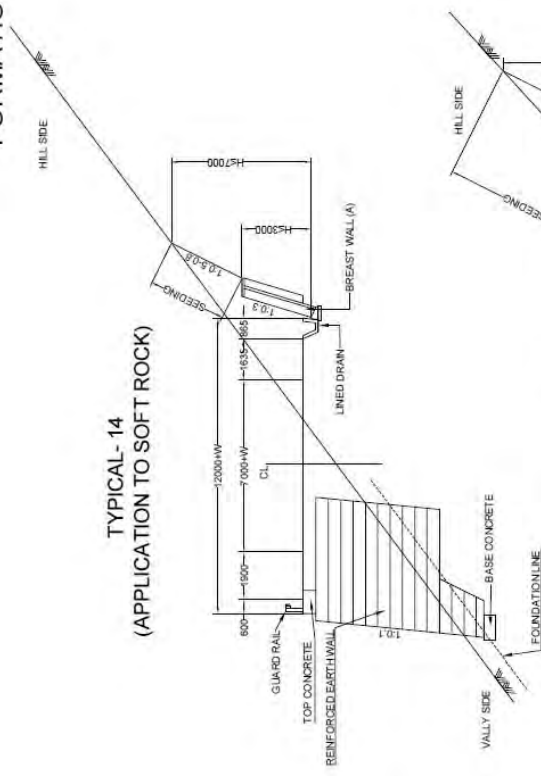
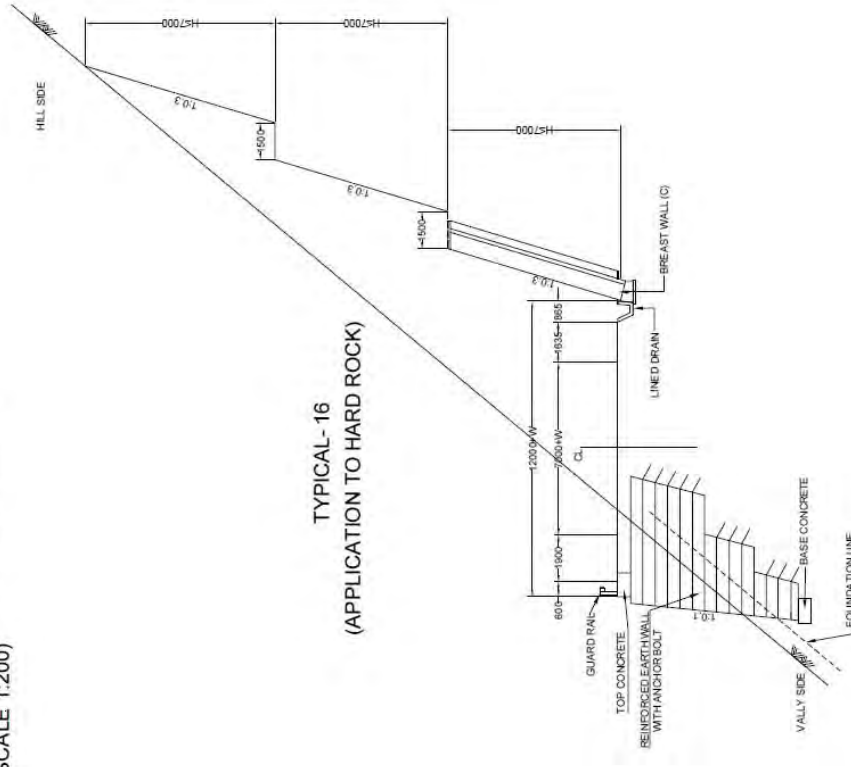
TYPICAL-13  
(APPLICATION TO SOFT ROCK)



NOTE : SEEDING ONLY ON 1:0.8 SLOPE

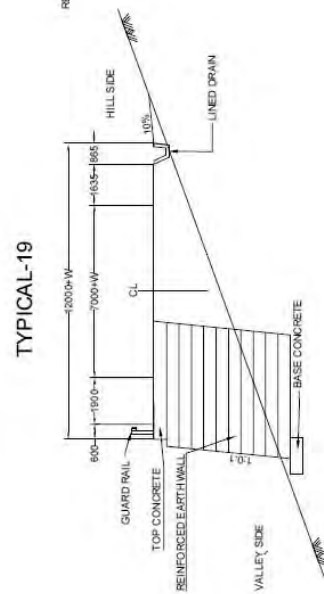
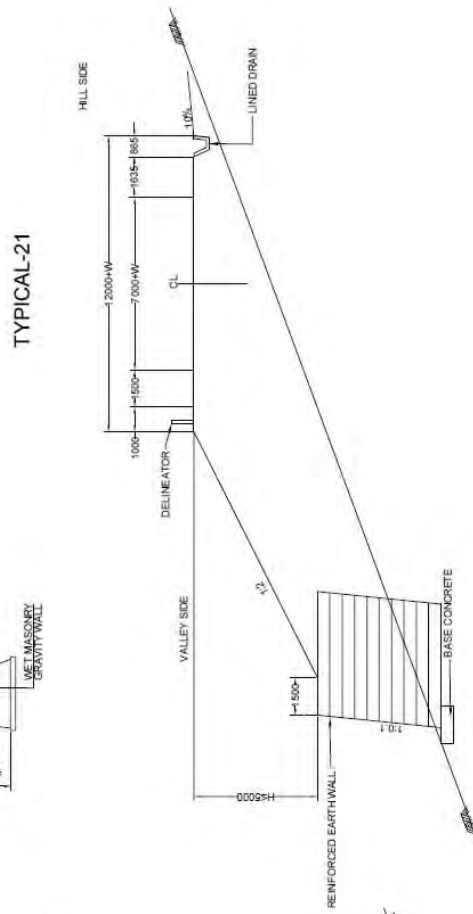
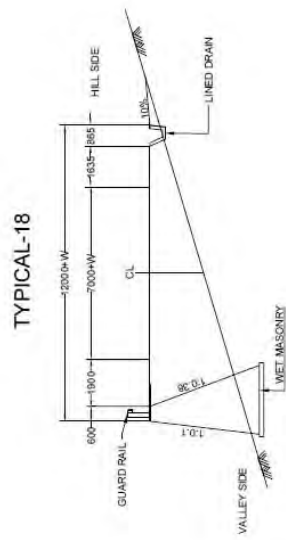
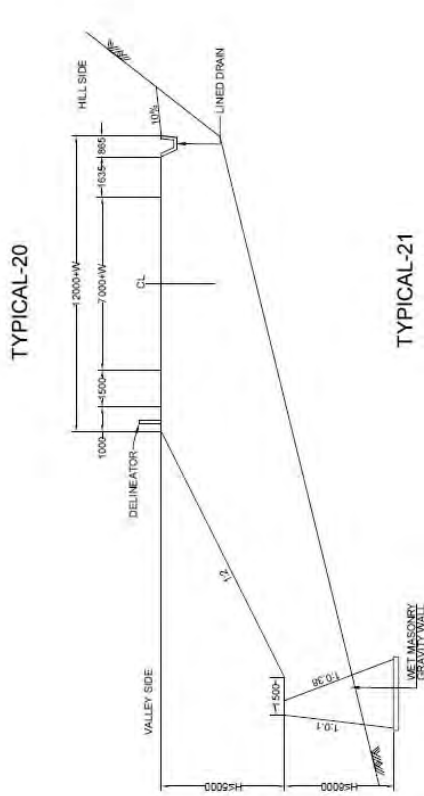
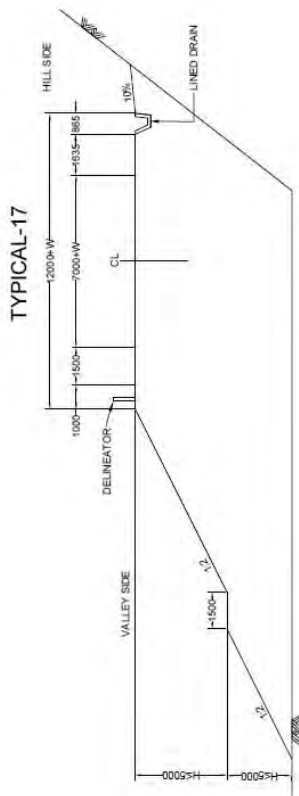


TYPICAL CROSS SECTION (4/6)  
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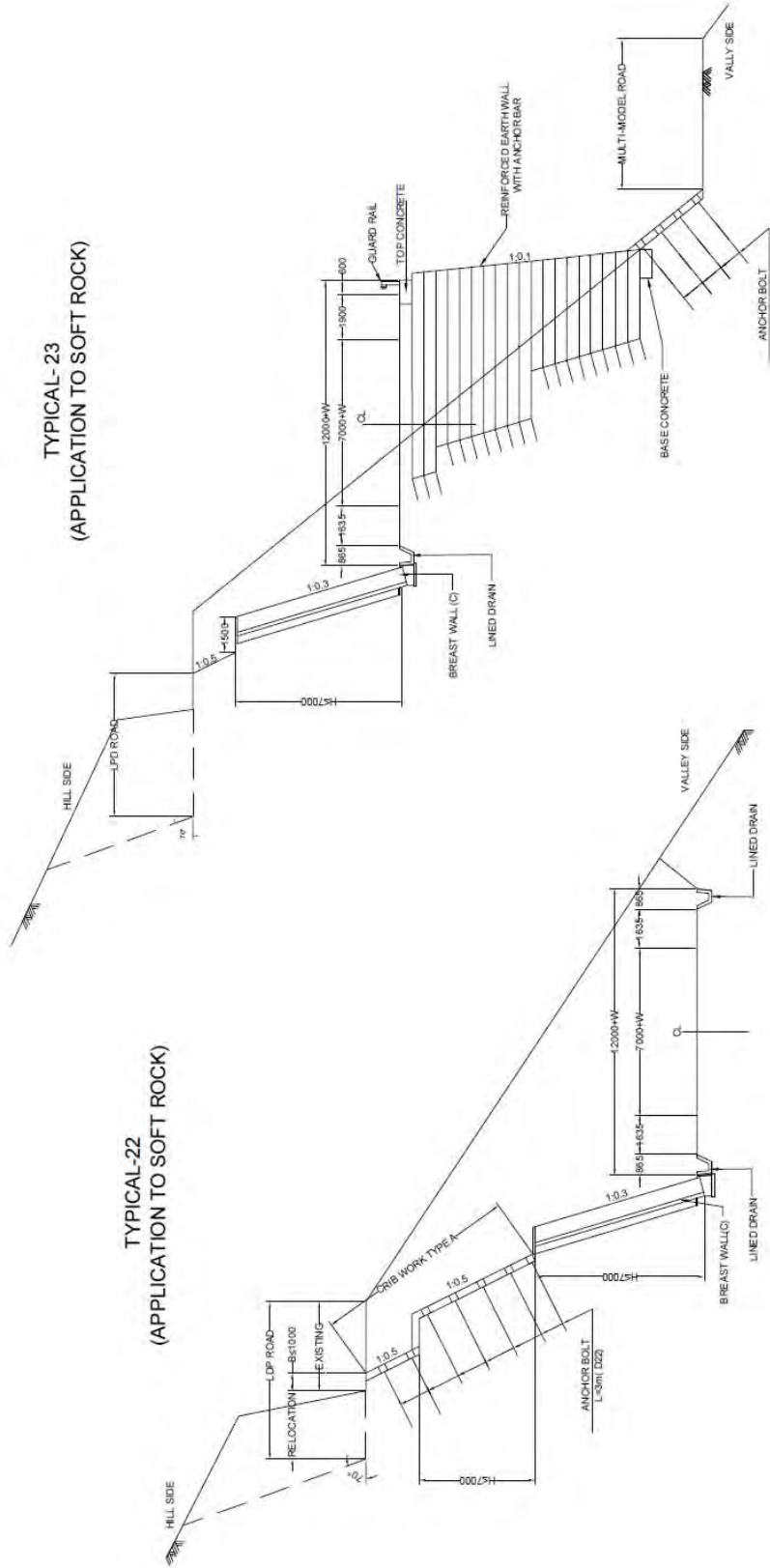


NOTE : SEEDING ONLY ON 1:0.8 SLOPE

TYPICAL CROSS SECTION (5/6)  
FORMATION IN EMBANKMENT  
SCALE 1:200



TYPICAL CROSS SECTION (6/6)  
 FORMATION IN CUTTING AND EMBANKMENT AT MULTI MODEL ROAD AND LDP ROAD  
 SCALE 1:200



# TYPICAL PAVEMENT DETAIL

SCALE 1:100

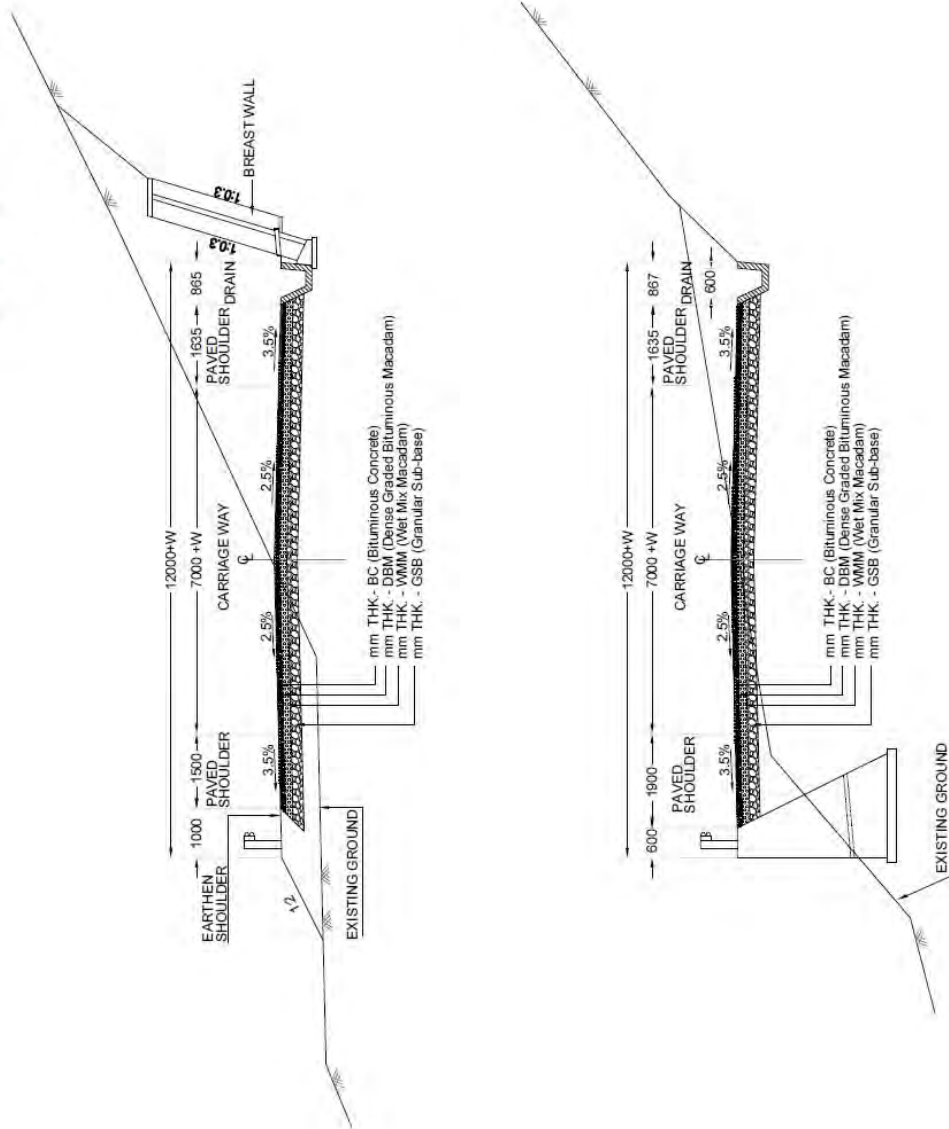


TABLE SECTION OF PAVEMENT DESIGN

TYPE	THICKNESS (mm)
BC	40
DBM	100
WMM	250
GSB	300

## Appendix-6: Flora and Fauna in Mizoram and Project Area

**Table A6-1 Floral Species in Mizoram and those Spotted in the Field Survey**

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
1	<i>Abelmoschus manihot</i>	Ladies Finger	Ui chhu me	Not Assessed		Spotted in Hnahthial
2	<i>Acacia intsia</i>	Acacia	Vawkpui-ruangruh	LC ver 3.1		Spotted in Hnahthial and Chhiahtlang
3	<i>Acacia pennata</i>	Climbing Acacia	Khanghu	LC ver 3.1		
4	<i>Acacia pruinescens</i>	--	Khangpawl	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
5	<i>Achyranthes aspera</i>	Chaff Flower	Ui-hlo	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
6	<i>Achyranthes bidentata</i>	Oxknee	Vangvat-hlo	Not Assessed		
7	<i>Acmella paniculata</i>	Spot Flower	Ankasate	LC ver 3.1		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
8	<i>Acmella uliginosa</i>	Marsh Cress	Ansate	LC ver 3.1		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
9	<i>Acrocarpus fraxinifolius</i>	Pink Cedar	Nganbawm	Not Assessed		
10	<i>Aeschynomene indica</i>	Curly indico	Hlo-nuar-suak	LC ver 3.1		
11	<i>Aganope thyrsoiflora</i>	--	Hulhu	Not Assessed		
12	<i>Ageratina adenophora</i>	Crofton Weed	Nepal-tlangsam	Not Assessed		
13	<i>Ageratum conyzoides</i>	Floss Flower	Vai len hlo	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
14	<i>Ageratum houstonianum</i>	Bluemink	Vai-lenhlo-chikhhat	Not Assessed		Spotted in Serchhip and Chhiahtlang
15	<i>Aglaia chittagonga</i>	Priyangu	Thehleikhak	LC ver 3.1		
16	<i>Aglaia edulis</i>	Droopy leaf	Rai-thei	Lower Risk/Near Threatened ver 3.1		
17	<i>Aglaomorpha coronans</i>	Santa Rose Fern	Awmvel/Tuai bur	Not Assessed		Spotted in Serchhip
18	<i>Alangium chinense</i>	Chinese Alangium	Arsa-rim-nam	Not Assessed		
19	<i>Albizia chinensis</i>	Chinese Albizia	Vang	Not Assessed		Spotted in Hnahthial, Serchhip and Chhiahtlang

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
20	<i>Albizia odoratissima</i>	Fragrant Albizia	Thingri	Not Assessed		
21	<i>Albizia procera</i>	White Siris	Kangtek	Not Assessed		
22	<i>Alocasia fallax</i>	Dwarf Taro	Zawng-bai-bing	Not Assessed		Spotted in Hnahthial
23	<i>Alseodaphne petiolaris</i>	--	Khuangthulh	Not Assessed		
24	<i>Alstonia scholaris</i>	Devil Tree	Thuamriat	LC ver 2.3		Spotted in Hnahthial, Serchhip and Chhiahtlang
25	<i>Amaranthus spinosus</i>	Thorny Pigweed	Lenhling	Not Assessed		Spotted in Hnahthial, Serchhip and Chhiahtlang
26	<i>Amaranthus viridis</i>	Green amaranth	Lenghling-hling-nei-lo	Not Assessed		Spotted in Hnahthial, Serchhip and Chhiahtlang
27	<i>Amomum maximum</i>	Java Cardamon	Aidu	Not Assessed		
28	<i>Ananas comosus</i>	Pineapple	La-khuih-thei	Not Assessed		Spotted in Hnahthial, Serchhip and Chhiahtlang
29	<i>Angiopteris evecta</i>	Giant Fern	Kawksa-ke	Not Assessed		
30	<i>Anogeissus acuminata</i>	Yon	Zairum	Not Assessed		
31	<i>Antidesma acidum</i>	Amti	Thurte an	Not Assessed		
32	<i>Antidesma bunius</i>	Bignay	Tuaitit	Not Assessed		
33	<i>Aporosa octandra</i>	--	Chhawntual	Not Assessed		
34	<i>Arenga pinnata</i>	Sugar Palm	Thangtung	Not Assessed		
35	<i>Aeridis rosea</i>	Orchids	Nauban	Not Assessed		Spotted in Hnahthial and Chhiahtlang
36	<i>Arisaema album</i>	Cobra lily	Mitthi-vaimim	Not Assessed		
37	<i>Artemisia vulgaris</i>	Mugwort	Sai	Not Assessed		
38	<i>Artocarpus heterophyllus</i>	Jackfruit	Lamkhuang	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
39	<i>Artocarpus lacucha</i>	Lakooch	Theitat	Not Assessed		
40	<i>Baccaurea ramiflora</i>	Bhooby Tree	Pangkai	Not Assessed		
41	<i>Balakata baccata</i>	Seleng	Thingvawkpui	Not Assessed		
42	<i>Bambusa spp.</i>	Bamboo		Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
43	<i>Bauhinia variegata</i>	Kachnar	Vaube	LC ver 3.1		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
44	<i>Bidens pilosa</i>	Black Jack	Vawkpuihal	Not Assessed		Spotted in Hnahthial and

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
						Chhiahtlang
45	<i>Bischofia javanica</i>	Uriam	khuangthli	Not Assessed		
46	<i>Blechnum spp.</i>		Kawk ma ther	Not Assessed		Spotted in Serchhip
47	<i>Bombax ceiba</i>	Semul	Phunchawng	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
48	<i>Bombax insigne</i>	Didu	Pang	Not Assessed		
49	<i>Breynia retusa</i>	Cup Saucer Plant	Pi-bengbeh	Not Assessed		
50	<i>Bruinsmia polysperma</i>	--	Theipaling-kawh	Not Assessed		
51	<i>Buddleja asiatica</i>	White Butterfly Bush	Serial	Not Assessed		
52	<i>Byttneria aspera</i>	--	Zawngluanghrui	Not Assessed		
53	<i>Byttneria pilosa</i>	--	Sazuknghawnghlap	Not Assessed		
54	<i>Cajanus goensis</i>	--	Zawngbete	Not Assessed		
55	<i>Callicarpa arborea</i>	Beautyberry Tree	Hnahkiah	Not Assessed		
56	<i>Camellia sinensis</i>	Tea	-	Not Assessed		Spotted in Chhiahtlang
57	<i>Carica papaya</i>	Papaya	Thing-fang-hma	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
58	<i>Caryota urens</i>	Solitary Fishtail Palm	Meihle	LC ver 3.1		
59	<i>Cassia fistula</i>	Amaltar	Ngai-ngaw	Not Assessed		
60	<i>Castanopsis tribuloides</i>	Chestnut	Thingsia	Not Assessed		
61	<i>Ceiba pentandra</i>	Ceiba	Japan-pang			Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
62	<i>Celtis tetrandra</i>	Nettle Tree	Anku	Not Assessed		
63	<i>Centella asiatica</i>	Pennywort	Lambak	LC ver 3.1		
64	<i>Cephalotaxus griffithii</i>	Griffith's Plum Yen	Thinglenbuan	Vulnerable ver 3.1		
65	<i>Cheilocostus speciosus</i>	Kew	Sumbul	Not Assessed		
66	<i>Chromolaena odorata</i>	Floss Flower	Tlangsam	Not Assessed		
67	<i>Chukrasia tabularis</i>	Chickrassy	Zawngtei	LC ver 3.1		
68	<i>Cinnamomum tamala</i>	Bay leaf	Hnahrimtui/Tejpata	Not Assessed		
69	<i>Cissampelos pareira</i>	Akanadi	Hnahbialhrui	Not Assessed		
70	<i>Cissus javana</i>	Begonia	Sanghar-hmai	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
						Chhiahtlang
71	<i>Cissus repens</i>	--	Hruipawl	Not Assessed		
72	<i>Clauseana excavata</i>	Pink Limberry	Arpa-sentil	Not Assessed		
73	<i>Clerodendrum glandulosum</i>	Glory Bower	Phuihnam	Not Assessed		
74	<i>Clerodendrum infortunatum</i>	Hillglory Flower	Phuihnamchhi a	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
75	<i>Colona floribunda</i>	--	Hnahthap	Not Assessed		
76	<i>Conyza bonariensis</i>	Hairy Horseweed	Buarzen	Not Assessed		
77	<i>Cordia fragrantissima</i>	--	Muk	Not Assessed		
78	<i>Croton caudatus</i>	Rushfoil	Ranlungdamd awi	Not Assessed		
79	<i>Cyathea chinensis</i>	--	Kawkpui	Not Assessed		
80	<i>Cymbidium spp</i>	Orchids	Nauban	Not Assessed		Spotted in Hnahthial and Chhiahtlang
81	<i>Cynodon dactylon</i>	Bermuda Grass	Phul	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
82	<i>Dalbergia obtusifolia</i>	--	Bianghrei	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
83	<i>Dalbergia stipulacea</i>	Himalayan Dalbergia	Hruizaizawh	Not Assessed		Spotted in Lawngtlai
84	<i>Debregeasia longifolia</i>	Orange Wild Rhea	Lehngo	Not Assessed		
85	<i>Dendrobium spp</i>	Dendrobium	Nauban	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
86	<i>Dendrocalamus hamiltonii</i>	Rhino Bamboo	Phulrua	Not Assessed		
87	<i>Dendrocalamus longispathus</i>	--	Rawnal	Not Assessed		
88	<i>Derris robusta</i>	Sea Derris	Thingkha	Not Assessed		
89	<i>Dimocarpus longan</i>	Lichi	Theifeimung	Near Threatened ver 3.1		
90	<i>Diospyros glandulosa</i>	--	Theivawkmit	Not Assessed		
91	<i>Dracaena spicata</i>	Dracaena	Phunhring	Not Assessed		
92	<i>Duabanga grandiflora</i>	Lampati	Zuang	Not Assessed		Spotted in Serchhip
93	<i>Dysoxylum excelsum</i>	--	Thingthupui	Not Assessed		
94	<i>Dysoxylum mollissimum</i>	--	Thingsaphu	Not Assessed		
95	<i>Elaeagnus latifolia</i>	Oleaster	Sarzukpui	Not Assessed		Spotted in Chhiahtlang



SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
96	<i>Elaeocarpus lanceifolius</i>	--	Kharuan	Not Assessed		
97	<i>Elaeocarpus rugosus</i>	--	Theikel ek	Vulnerable ver 3.1		
98	<i>Elaeocarpus serratus</i>	Rosserynut	Vantha	Not Assessed		
99	<i>Elaeocarpus tectorius</i>	--	Umkhal	Not Assessed		
100	<i>Embelia ribes</i>	Embelia	Naufadawntua i	Not Assessed		
101	<i>Embelia vestita</i>	--	Tling	Not Assessed		
102	<i>Engelhardtia spicata</i>	Silapoma	Hnum	LC ver 3.1		
103	<i>Ensete glaucum</i>	Snow Banana	Saisu	Not Assessed		
104	<i>Entada phaseoloides</i>	Ghila	Kawihru	Not Assessed		Spotted in Serchhip
105	<i>Eranthemum strictum</i>	--	Lentupui	Not Assessed		
106	<i>Eriobotrya bengalensis</i>	--	Nghalchhun	Not Assessed		
107	<i>Erythrina stricta</i>	Tiger Claw	Fartuah	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
108	<i>Etlingera linguiformis</i>	--	Buh-ai	Not Assessed		
109	<i>Eulalia trispicata</i>	--	Thang	Not Assessed		
110	<i>Euphorbia hirta</i>	Lal Dhudi	Zawhte-hlo	Not Assessed		
111	<i>Euphorbia spp.</i>		Chawng	Not Assessed		Spotted in Lawngtlai
112	<i>Eurya japonica</i>	Japanese Eurya	Sihneh	Not Assessed		
113	<i>Ficus auriculata</i>	Elephant Ear Fig	Theibal	Not Assessed		
114	<i>Ficus curtipes</i>	Bluntleaf Fig	Hnahhlun	Not Assessed		Spotted in Hnahthial
115	<i>Ficus elastica</i>	Indian rubber	Thelret	Not Assessed		
116	<i>Ficus hirta</i>	Hairy Fig	Sazutheipui	Not Assessed		
117	<i>Ficus hispida</i>	Devil Fig	Paihtemaian	Not Assessed		
118	<i>Ficus prostrata</i>	--	Theitit	Not Assessed		
119	<i>Ficus racemosa</i>	Goolar	Theichek/Chh ohe	Not Assessed		
120	<i>Ficus retusa</i>	Laurel Fig	Rihnim	Not Assessed		
121	<i>Ficus semicordata</i>	Drooping Fig	Theitit/Theipui i	Not Assessed		
122	<i>Ficus virens</i>	White Fig	Zaihri	Not Assessed		
123	<i>Firmiana colorata</i>	Bonefire Tree	Khaukhim	Not Assessed		
124	<i>Flacourtia jangomas</i>	Coffee Plum	Awmtawt	Not Assessed		
125	<i>Flueggea virosa</i>	Whiteberry Bush	Saisiak	Not Assessed		
126	<i>Garcinia lanceifolia</i>	--	Chengkek	Not Assessed		
127	<i>Garuga floribunda</i>	Garuga	Tuairam	Not Assessed		
128	<i>Garuga pinnata</i>	Garuga	Bungbutuairam	Not Assessed		

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
129	<i>Girardinia diversifolia</i>	Himalayan Nettle	Taiten	Not Assessed		
130	<i>Globba wengeri</i>	Dancing Girl	Ai-thing	Not Assessed		
131	<i>Glochidion heyneanum</i>	Velvety melon Featherfoil	Thingpawnh hia	Not Assessed		
132	<i>Glycosmis pentaphylla</i>	Ash Sheora	Arpatil	Not Assessed		
133	<i>Gmelina arborea</i>	Gomari	Thlanvawng	Not Assessed		
134	<i>Gnetum gnemon</i>	Joint Fir	Pelh	LC ver 3.1		
135	<i>Goniothalamus sesquipedalis</i>	--	Kham	Not Assessed		
136	<i>Gynocardia odorata</i>	Chaulmugra	Saithei	Not Assessed		
137	<i>Haematocarpus validus</i>	--	Theichhungse n	Not Assessed		
138	<i>Hedyotis scandens</i>	--	Laikingtuibur	Not Assessed		
139	<i>Helicia excelsa</i>	--	Sialhma	Not Assessed		
140	<i>Heritiera papilio</i>	--	Thingsaiphaw	Not Assessed		
141	<i>Heteropanax fragrans</i>	Fragrant Aralia	Changkhen	Not Assessed		
142	<i>Hodgsonia heteroclita</i>	Chinese lordplant	Kha-um	Not Assessed		
143	<i>Homalomena aromatica</i>	Sugandhmati	Anchiri	Not Assessed		
144	<i>Hovenia dulcis</i>	Japanese Raisin Tree	Vautangbawk	Not Assessed		
145	<i>Hoya longifolia</i>	--	Hnahchhah	Not Assessed		
146	<i>Hydnocarpus kurzii</i>	Chaulmugra	Khawitur	DD ver 3.1		
147	<i>Ipomoea hederifolia</i>	Scarlet Creeper	Nipuiar	Not Assessed		
148	<i>Jasminum coarctatum</i>	--	Hlokha	Not Assessed		
149	<i>Jasminum nervosum</i>	Wild Kunda	Hruikha	Not Assessed		
150	<i>Juglans regia</i>	Walnut Tree	Khawkherh	Near Threatened ver 3.1		
151	<i>Kydia glabrescens</i>	--	Hnahbialthing	Not Assessed		
152	<i>Lagerstroemia speciosa</i>	Jarul	Thlado	Not Assessed		Spotted in Serchhip
154	<i>Lansea coromandelica</i>	Jhingan	Tawitaw-suak	Not Assessed		
155	<i>Laurocerasus undulata</i>	--	Theiarlung	Not Assessed		
156	<i>Leea indica</i>	Banicoat Berry	Kawlkar	Not Assessed		
157	<i>Leea compactiflora</i>	--	Kumtintuai	Not Assessed		
158	<i>Leucosceptrum canum</i>	--	Kawihthuang	Not Assessed		
159	<i>Ligustrum robustum</i>	Wild Preefet	Chawmzil	Not Assessed		
160	<i>Lindernia ruellioides</i>	Duckbill Pimpernel	Thasuih	LC ver 3.1		
161	<i>Lithocarpus dealbata</i>	Oak	Fah	--		
162	<i>Lithocarpus elegans</i>	Spike Oaks	Thingpuithing hnahsin	Not Assessed		

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
163	<i>Litsea cubeba</i>	Cubeba	Sernam	Not Assessed		
164	<i>Lobelia pyramidalis</i>	Lobelia	Berawchal	Not Assessed		
165	<i>Lygodium japonicum</i>	Climbing fern	Dawnzem	Not Assessed		
166	<i>Macaranga denticulata</i>	Mallata	Kharpa	Not Assessed		
167	<i>Macaranga peltata</i>	Chandada	Kharduap	Not Assessed		
168	<i>Maesa montana</i>	Maesa	Arngeng	Not Assessed		
169	<i>Magnolia champaca</i>	Champa	Ngiau	LC ver 3.1		
170	<i>Magnolia hodgsonii</i>	Heart Flower	Thingtumbu	LC ver 3.1		
171	<i>Mallotus paniculatus</i>	Panicled Mallotus	Kharpawl	Not Assessed		
172	<i>Mallotus philippensis</i>	Rohini	Thingkhei	Not Assessed		
173	<i>Mammea suriga</i>	Surangi	Suktlawng	Not Assessed		
174	<i>Mangifera indica</i>	Am	Ramtheihai	Data Deficient ver 3.1		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
175	<i>Melocalamus compactiflorus</i>	Pear Bamboo	Sairil	Not Assessed		
176	<i>Melocanna baccifera</i>	Muli Bamboo	Mautak	Not Assessed		
177	<i>Merremia umbullata</i>	Hogvine	Thianpa	–		
178	<i>Merremia vitifolia</i>	Grape glory	Thiannu	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
179	<i>Mesua ferrea</i>	Mesua	Herhse	Not Assessed		Spotted in Hnahthial, Serchhip and Chhiahtlang
180	<i>Micromelum minutum</i>	Orangeberry	Vawkpuitaise n	Not Assessed		
181	<i>Mikania micrantha</i>	Bittervine	Japanhlo	Not Assessed		
182	<i>Milletia pachycarpa</i>	--	Rulei	–		
183	<i>Mimosa pudica</i>	Shameplant	Hlonuar	LC ver 3.1		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
184	<i>Molinieria capitulata</i>	Palm Grass	Phaiphak	–		
185	<i>Morinda angustifolia</i>	Thin leaved Morinda	Lum	–		
186	<i>Mucuna bracteata</i>	--	Hruidak	LC ver 3.1		
187	<i>Mucuna imbricata</i>	Lyon Bean	Zawngkawi	LC ver 3.1		
188	<i>Mucuna pruriens</i>	Velvet Bean	Uiteme	Not Assessed		
189	<i>Musa spp.</i>	Banana	Vaibalhla/Changthir	Not Assessed		
190	<i>Mussaenda roxburghii</i>	Himalayan Mussaenda	Vakep	Not Assessed		
191	<i>Neolamarkia cadamba</i>	Kadam	Banphar			

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
192	<i>Neonauclea purpurea</i>	Phuga	Lungkhup	Not Assessed		
193	<i>Oroxylum indicum</i>	Pharra	Archangkawm	Not Assessed		
194	<i>Osbeckia crinita</i>	--	Builukham	Not Assessed		
195	<i>Ostodes paniculata</i>	Paniculate Ostodes	Beltur	Not Assessed		
196	<i>Oxyspora paniculata</i>	Oxyspora	Khampa/Khampui	Not Assessed		Spotted in Hnahthial
197	<i>Parkia timoriana</i>	Tree bean	Zawngtah	Not Assessed		
198	<i>Passiflora nepalensis</i>	--	Nauawimuhru	Not Assessed		
199	<i>Pericampylus glaucus</i>	Mooseed	Khauchhim	Not Assessed		
200	<i>Persicaria chinensis</i>	Chinese Knotweed	Taham	Not Assessed		
201	<i>Phyllanthus emblica</i>	Amla	Sunhlu	Not Assessed		
202	<i>Phyllanthus urinaria</i>	Hazarmani	Mitthi-sunhlu	Not Assessed		
203	<i>Physalis angulata</i>	Wild Gooseberry	Kelasairawphit	Not Assessed		
204	<i>Plantago major</i>	Cart track plant	Kelbaan	Not Assessed		
205	<i>Pleione praecox</i>	--	Nauban	Not Assessed		
206	<i>Protium serratum</i>	Murtenga	Bil	Not Assessed		
207	<i>Pteris vittata</i>	Lader Brake Fern	Chakawkte	LC ver 3.1		
208	<i>Pterospermum acerifolium</i>	Kanak Champa	Siksil	Not Assessed		
209	<i>Rhus chinensis</i>	Nutgall Tree	Khawmhma	Not Assessed		
210	<i>Rothea serrata</i>	Bharangi	Leidumsuak	Not Assessed		
211	<i>Rubus alceifolius</i>	Black Cherry	Sialinutheihmu	Not Assessed		
212	<i>Rubus niveus</i>	Hill raspberry	Hmupa	Not Assessed		
213	<i>Rhynchostylis retusa</i>	Foxtail orchid	Nauban parbawr	Not Assessed		Spotted in Hnahthial and Chhiahtlang
214	<i>Saccharum arundinaceum</i>	Hardy sugar cane	Rai ruang	Not Assessed		Spotted in Lawngtlai, Hnahthial and Chhiahtlang
215	<i>Saccharum longisetosum</i>	--	Luang	--		Spotted in Lawngtlai, Hnahthial and Chhiahtlang
216	<i>Sapindus mukorossi</i>	Reetha	Hlingsi	Not Assessed		
217	<i>Sapium eugeniaefolium</i>	--	Kausen	--		
218	<i>Saraca asoca</i>	Saraca	Mualhawih	Vulnerable ver 2.3		
219	<i>Schefflera venulosa</i>	Dwarf Umbrella Plant	Kelbuh	Not Assessed		
220	<i>Schima wallichii</i>	Chilauri	Khiang	Not Assessed		
221	<i>Scoparia dulcis</i>	sweet Broom weed	Thlumdemdem	Not Assessed		
222	<i>Senna tora</i>	Foetid Cassia	Kelbe	Not Assessed		Spotted in

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
						Lawngtlai, Hnahthial and Chhiahtlang
223	<i>Setaria palmifolia</i>	Palm Grass	Hnahhrat	Not Assessed		
224	<i>Sida acuta</i>	Ban methi	Khingkhiah	Not Assessed		
225	<i>Smilax glabra</i>	Chinese Smilax	Tluangngil	Not Assessed		
226	<i>Solanum anguivi</i>	Indian Nightshade	Tawkte	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
227	<i>Solanum nigrum</i>	Black Nightshade	Anhling	Not Assessed		
228	<i>Solanum rupestris</i>	Turkeyberry	Tawkpui	Not Assessed		
229	<i>Solanum viarum</i>	--	Athlo	Not Assessed		
230	<i>Sonchus arvensis</i>	Corn saw Thistle	Khuanglawi	Near Threatened ver 3.1		
231	<i>Spondias pinnata</i>	Amra	Tawitaw	Not Assessed		
232	<i>Stemona tuberosa</i>	Wild Asparagus	Sang	Not Assessed		
233	<i>Sterculia lanceifolia</i>	--	TlingilehNga mainchhawth uaina	Not Assessed		
234	<i>Sterculia villosa</i>	Udal	Khaupui	Not Assessed		
235	<i>Stereospermum chelonoides</i>	Pader	Zihngal	Not Assessed		
236	<i>Stixis suaveolens</i>	--	Theisawntlung	Not Assessed		
237	<i>Strobilanthes capitatus</i>	--	Ramting/Tumau	Not Assessed		
238	<i>Syzygium cumini</i>	Jaman	Lenhmui/Hmuipui	Not Assessed		
239	<i>Tabernaemontana divaricata</i>	Wax Flower	Kelbengbeh	Not Assessed		
240	<i>Terminalia myriocarpa</i>	Hollock	Char	Not Assessed		Spotted in Hnahthial, Serchhip and Chhiahtlang
241	<i>Tetrameles nudiflora</i>	Maina	Thingdawl	LC ver 2.3		
242	<i>Themeda villosa</i>	Lyon's Grass	Phaiphek	Not Assessed		
243	<i>Thladiantha cordifolia</i>	Golden Creeper	Kangmang	Not Assessed		
244	<i>Thunbergia alata</i>	Sky flower	Vako	Not Assessed		
245	<i>Thysanolaena latifolia</i>	Bamboo Grass	Hmunphiah	Not Assessed		Spotted in Lawngtlai, Hnahthial, Serchhip and Chhiahtlang
246	<i>Tithonia diversifolia</i>	Mexican Sunflower	Vaivakawnpar	Not Assessed		
247	<i>Toona ciliata</i>	Toon	Teipui	LC ver 2.3		
248	<i>Toxicodendron succedaneum</i>	Wax Tree	Chhimhruk	Not Assessed		
249	<i>Trema orientalis</i>	Charcoal Tree	Belphuar	Not Assessed		

SL. NO.	Botanical Name	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
250	<i>Trevesia palmata</i>	Snowflake Tree	Kawhteibel	Not Assessed		
251	<i>Trichosanthes cordata</i>	--	Van-um	Not Assessed		
252	<i>Trichosanthes tricuspudata</i>	Redball snakeground	Choakaum	Not Assessed		
253	<i>Triumfetta bogotensis</i>	--	Semeibawm	Not Assessed		
254	<i>Ulmus lanceifolia</i>	Eastern elm	Phan	Not Assessed		
255	<i>Urena lobata</i>	Caesar weed	Sehnap	Not Assessed		
256	<i>Vernonia volkameriifolia</i>	Himalayan Tree Vernonia	Tlaka-zangzaw	Not Assessed		
251	<i>Vitex canescens</i>	--	Thingsaihlum	Not Assessed		
252	<i>Vitex peduncularis</i>	--	Thingkhawilu pa	Not Assessed		
253	<i>Vitex quinata</i>	--	Thlengreng	Not Assessed		
254	<i>Zanthoxylum budrunga</i>	Indian Prickly ash	Chingit	Not Assessed		
255	<i>Ziziphus incurva</i>	--	Hel	Not Assessed		
256	<i>Ziziphus oenoplia</i>	Jackal Jujube	Muvanlaihling /Nghardai	-		Spotted in Serchhip

**Table A6-2 Fauna Species in Mizoram and those Spotted in the Field Survey**

Sl. No.	Zoological names	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
<b>MAMMALS</b>						
1	<i>Arctictis binturong</i>	Binturong	Zamphu	Vulnerable ver 3.1	Schedule I	Not spotted
2	<i>Arctonyx collaris</i>	Hog Badger	Phivawk	Nearly Threatened ver 3.1	Schedule II	Not spotted
3	<i>Callosciurus erythraeus</i>	Pallas's/ red bellied tree Squirrel	Hleikapsen	Least Concern ver 3.1	Schedule II	Spotted
4	<i>Callosciurus pygerythrus</i>	Hoary billed Squirrel	Hleilubial	Least Concern ver 3.1	Schedule II	Not spotted
5	<i>Canis aureus</i>	Golden Jackal	Sihal	Vulnerable ver 3.1	Schedule II	Not spotted
6	<i>Capricornis rubidus</i>	Red Serrow	Saza	Nearly Threatened ver 3.1	Schedule I	Not spotted
7	<i>Catopuma temminckii</i>	Asiatic Golden Cat	Keisen	Nearly Threatened ver 3.1	Schedule I	Not spotted
8	<i>Dremomys lokriah</i>	Orange bellied Himalayan Squirrel	Hleimeipar	Least Concern ver 3.1	Schedule II	Not spotted
9	<i>Felis chaus</i>	Jungle Cat	Sa-uak	Least Concern ver 3.1	Schedule II	Not spotted
10	<i>Helarctos malayanus</i>	Sun Bear	Samang	Vulnerable ver 3.1	Schedule I	Not spotted
11	<i>Herpestes urva</i>	Crab eating Mongoose	Saphai-ruang	Least Concern ver 3.1	Schedule IV	Not spotted

Sl. No.	Zoological names	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
12	<i>Hoolock hoolock</i>	Western Hoolock Gibbon	Hauhuk	Endangered ver 3.1	Schedule I	Not spotted
13	<i>Hystrix brachyura</i>	Malayan Porcupine	Sa-kuh	Least Concern ver 3.1	Schedule II	Not spotted
14	<i>Macaca assamensis</i>	Assam Macaque	Zo-zawng	Nearly Threatened ver 3.1	Schedule II	Not spotted
15	<i>Macaca mulatta</i>	Rhesus Monkey	Phaizawng	Least Concern ver 3.1	Schedule II	Not spotted
16	<i>Manis pentadactyla</i>	Chinese Pangolin	Saphu	Critically Endangered ver 3.1	Schedule I	Not spotted
17	<i>Martes flavigula</i>	Yellow throated Martes	Safia	Least Concern ver 3.1	Schedule II	Not spotted
18	<i>Melogale moschata</i>	Small toothed Ferreet Badger	Sahmaitha	Least Concern ver 3.1	Schedule II	Not spotted
19	<i>Muntiacus vaginalis</i>	Northern Red Muntjac	Sa-khi	Least Concern ver 3.1	Schedule III	Not spotted
20	<i>Nycticebus bengalensis</i>	Bengal Slow Loris	Sahuai	Vulnerable ver 3.1	Schedule I	Not spotted
21	<i>Paguma larvata</i>	Masked Palm Civet	Zaw-buang	Least Concern ver 3.1	Schedule II	Not spotted
22	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	Zawhang/Zaw-reng	Least Concern ver 3.1	Schedule II	Not spotted
23	<i>Petaurista petaurista</i>	Common Giant flying squirrel	Vahluk	Least Concern ver 3.1	Schedule II	Not spotted
24	<i>Prionailurus bengalensis</i>	Leopard Cat	Ngharfang	Least Concern ver 3.1	Schedule I	Not spotted
25	<i>Ratufa bicolor</i>	Black Giant Squirrel	Awrrang	Nearly Threatened ver 3.1	Schedule II	Not spotted
27	<i>Sus scrofa</i>	Wild Boar	Sanghal	Least Concern ver 3.1	Schedule III	Not spotted
28	<i>Tamias macclellandi</i>	Himalayan Striped Squirrel	Hleimualrang	Least Concern ver 3.1	Schedule II	Not spotted
29	<i>Trachypithecus pileatus</i>	Capped langur	Ngaubuang	Vulnerable ver 3.1	Schedule I	Not spotted
30	<i>Tupaia belangeri</i>	Northern Tree Shrew	Chepa	Least Concern ver 3.1	Schedule V	Not spotted
31	<i>Ursus thibetanus</i>	Asiatic Black Bear	Savawm	Vulnerable ver 3.1	Schedule I	Not spotted
<b>BIRDS</b>						
1	<i>Accipiter badius</i>	Shikra	Mu-te	Least Concern ver 3.1	Schedule I	Spotted in Serchhip
2	<i>Abroscopus spp.</i>	Warbler	Va-te	Least Concern ver 3.1	Schedule IV	Not spotted
3	<i>Acridotheres fuscus</i>	Jungle Myna	Vaiva	Least Concern ver 3.1	Schedule IV	Not spotted
4	<i>Aegithina tiphia</i>	Common Iora	Zairumva	Least Concern ver 3.1	Schedule IV	Not spotted

Sl. No.	Zoological names	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
5	<i>Aethopyga spp.</i>	Sunbird	Dawthiama-ar	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
6	<i>Alcedo spp.</i>	Kingfisher	Kaikuangral	Least Concern ver 3.1	Schedule IV	Not spotted
7	<i>Alcippe nipalensis</i>	Nepal Fulvetta	Mitval	Least Concern ver 3.1	Schedule IV	Not spotted
8	<i>Alophoixus flaveolus</i>	White throated Bulbul	Daw-kek	Least Concern ver 3.1	Schedule IV	Not spotted
9	<i>Anthus spp.</i>	Pipit	Chip	Least Concern ver 3.1	Schedule IV	Not spotted
10	<i>Arachnothera magna</i>	Streaked Spiderhunter	Kireuh	Least Concern ver 3.1	Schedule IV	Not spotted
11	<i>Artamus fuscus</i>	Ashy Wood Shallow	Lengder	Least Concern ver 3.1	Schedule IV	Not spotted
12	<i>Bambusicola fytchii</i>	Mountain Bamboo Partridge	Vahlah	Least Concern ver 3.1	Schedule I	Not spotted
13	<i>Caprimulgus spp.</i>	Large tailed Nightjar	Valambawk	Least Concern ver 3.1	Schedule IV	Not spotted
14	<i>Carpodacus erythrinus</i>	Common Rosefinch	Vasuih	Least Concern ver 3.1	Schedule IV	Not spotted
15	<i>Chaimarrornis leucocephalus</i>	River Chat	Vachalde	Least Concern ver 3.1	Schedule IV	Not spotted
16	<i>Chalcohaps indica</i>	Emerald Dove	Ramparva	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip
17	<i>Chloropsis spp.</i>	Leaf Bird	Chhawhring	Least Concern ver 3.1	Schedule IV	
18	<i>Copsychus spp.</i>	White rumped Shama	Vatelal	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
19	<i>Coracias benghalensis</i>	Indian Roller	Va-pui	Least Concern ver 3.1	Schedule IV	Not spotted
20	<i>Coracina macei</i>	Larae Cuckoo Shrike	Irliak	Least Concern ver 3.1	Schedule IV	Not spotted
21	<i>Corvus macrohynchos</i>	Jungle Crow	Cho-ak	Least Concern ver 3.1	Schedule IV	Not spotted
22	<i>Cuculus micropterus</i>	Indian Cuckoo	Thangfenpawp	Least Concern ver 3.1	Schedule IV	Not spotted
23	<i>Cyornis spp.</i>	Flycatcher	Vapawl/Vad umdeleng	Least Concern ver 3.1	Schedule IV	Not spotted
24	<i>Dendrocitta formosa</i>	Grey Treepie	Bemkawng	Least Concern ver 3.1	Schedule IV	Not spotted
25	<i>Dendrocopos spp.</i>	Fulvous Woodpecker	Thlohkawrha	Least Concern ver 3.1	Schedule IV	Not spotted
26	<i>Dendronanthus indicus</i>	Forest Wagtail	Se-hnungzui	Least Concern ver 3.1	Schedule IV	Not spotted
27	<i>Dicaeum spp.</i>	Flower Pecker	Vate/Tiktik	Least Concern ver 3.1	Schedule IV	Not spotted
28	<i>Dicrurus aeneus</i>	Bronzed Drongo	Thlanthla	Least Concern ver 3.1	Schedule IV	Not spotted
29	<i>Dicrurus hottentottus</i>	Spangled Drongo	Kulherh	Least Concern ver 3.1	Schedule IV	Not spotted



Sl. No.	Zoological names	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
30	<i>Dicrurus leucophaeus</i>	Ashy Drongo	Kakpawl	Least Concern ver 3.1	Schedule IV	Not spotted
31	<i>Dicrurus macrocercus</i>	Black drongo	Thlanthlapu i	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
32	<i>Dicrurus paradiseus</i>	Greater Racket Tailed Drongo	Vakul	Least Concern ver 3.1	Schedule IV	Not spotted
33	<i>Dicrurus remifer</i>	Lesser Racket Tailed Drongo	Changhlawi	Least Concern ver 3.1	Schedule IV	Not spotted
34	<i>Ducula badia</i>	Mountain Imperial Pigeon	Bullut	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
35	<i>Enicurus spp.</i>	Spotted Forktail	Chinrang	Least Concern ver 3.1	Schedule IV	Not spotted
36	<i>Eunyias thallasina</i>	Flycatcher	Vapawl	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
37	<i>Gallus gallus</i>	Red Jungle Fowl	Ram-ar	Least Concern ver 3.1	Schedule IV	Not spotted
38	<i>Garrulax spp.</i>	Laughing Thrush	Va-zar	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip
39	<i>Glaucidium brodiei</i>	Collared Pigmy Owlet	Hrangkir	Least Concern ver 3.1	Schedule IV	Not spotted
40	<i>Gracula religiosa</i>	Hill Myna	Vaiva-diarkhim	Least Concern ver 3.1	Schedule I	Not spotted
41	<i>Hemixos flavala</i>	Ashy Bulbul	Kawlrit	Least Concern ver 3.1	Schedule IV	Not spotted
42	<i>Hieraetus kienerii</i>	Rufuas-bellied Eagle	Mu-arla	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip
43	<i>Hierococcyx sparverioides</i>	Large Hawk Cuckoo	Biakbairaw k	Least Concern ver 3.1	Schedule IV	Not spotted
44	<i>Hierococcyx varius</i>	Brain fever Bird	Kiltheihraw k	Least Concern ver 3.1	Schedule IV	Not spotted
45	<i>Lanius spp.</i>	Chhemhur	Chhemhur	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip
46	<i>Lonchura spp.</i>	Munia	Pit	Least Concern ver 3.1	Schedule IV	Spotted
47	<i>Lophura leucomelanos</i>	Kalij Pheasant	Va-hrit	Least Concern ver 3.1	Schedule I	Not spotted
48	<i>Macropygia unchall</i>	Barred Cuckoo Dove	Thumi-mei-sei	Least Concern ver 3.1	Schedule IV	Not spotted
49	<i>Megalaima lineata</i>	Lineated Barbet	Phaitawllaw t	Least Concern ver 3.1	Schedule IV	Not spotted
50	<i>Megalaima virens</i>	Great Barbet	Zotawllawt	Least Concern ver 3.1	Schedule IV	Not spotted
51	<i>Meghalaima asiatica</i>	Blue throated Barbet	Tuklo	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip and Chhiahtlang
52	<i>Monticola solitarius</i>	Blue Rock Thrush	Vainrongha k	Least Concern ver 3.1	Schedule IV	Not spotted
53	<i>Motacilla spp.</i>	Wagtail	Lailen	Least Concern ver 3.1	Schedule IV	Not spotted
54	<i>Niltava spp.</i>	Flycatcher	Beairal/Vapawl	Least Concern ver 3.1	Schedule IV	Not spotted

Sl. No.	Zoological names	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
55	<i>Nyctornis athertoni</i>	Blue Beard Bee Eater	Tlak-awrh	Least Concern ver 3.1	Schedule IV	Not spotted
56	<i>Oriolus traillii</i>	Maroon Oriole	Changsen	Least Concern ver 3.1	Schedule IV	Not spotted
57	<i>Orthotomus spp.</i>	Tailorbird	Daikat	Least Concern ver 3.1	Schedule IV	Not spotted
58	<i>Pericrocotus spp.</i>	Scarlet Minivet	Bawng	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
59	<i>Pernis ptilorhyncus</i>	Oriental Honey Buzzard	Khuai-mu	Least Concern ver 3.1	Schedule IV	Not spotted
60	<i>Phaenicophaeus tristis</i>	Green billed Malkoha	Va-zun	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
61	<i>Phodilus badius</i>	Oriental Bay Owl	Tahngai-bengnei	Least Concern ver 3.1	Schedule IV	Not spotted
62	<i>Phylloscopus spp.</i>	Warbler	Vate	Least Concern ver 3.1	Schedule IV	Not spotted
63	<i>Picus chloroplus</i>	Lesser yellownape Woodpecker	Thlohlpur	Least Concern ver 3.1	Schedule IV	Not spotted
64	<i>Pitta sordida</i>	Hooded Pitta	Buarchawm	Least Concern ver 3.1	Schedule IV	Not spotted
65	<i>Pomatorhinus spp.</i>	Babbler	Ngalvapual	Least Concern ver 3.1	Schedule IV	Not spotted
66	<i>Psittacula spp.</i>	Rose ringed Parakeet	Va-ki	Least Concern ver 3.1	Schedule IV	Not spotted
67	<i>Pycnonotus cafer</i>	Red Vented Bulbul	Tlaiberh	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
68	<i>Pycnonotus spp.</i>	Black Crested Bulbul	Tukkhumvilik	Least Concern ver 3.1	Schedule IV	Not spotted
69	<i>Rhipidura albicollis</i>	White throated Fantail Flycatcher	Chang-arh	Least Concern ver 3.1	Schedule IV	Not spotted
70	<i>Rimator malacoptilus</i>	Long billed Wren Babbler	Hmunchhe-arpui	Least Concern ver 3.1	Schedule IV	Not spotted
71	<i>Sitta spp.</i>	Nuthatch	Suklet	Least Concern ver 3.1	Schedule IV	Not spotted
72	<i>Spelacornis longicaudatus</i>	Tawny Breasted Wren Babbler	Va-lei-sawt	Vulnerable	Schedule IV	Not spotted
73	<i>Spilornis cheela</i>	Crested Serpent Eagle	Muvanlai	Least Concern ver 3.1	Schedule IV	Not spotted
74	<i>Streptopelia chinensis</i>	Spotted Dove	Thuro	Least Concern ver 3.1	Schedule IV	Spotted in Chhiahtlang
75	<i>Sturnus malabaricus</i>	Grey headed Myna	Va-pawl	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip and Chhiahtlang
76	<i>Treron spp.</i>	Green Pigeon	Vahui	Least Concern ver 3.1	Schedule IV	Not spotted
77	<i>Turdus bouboul</i>	Grey winged Blackbird	Vadartle	Least Concern ver 3.1	Schedule IV	Not spotted
78	<i>Turnix suscitator</i>	Barred Button Quail	Vahmim	Least Concern ver 3.1	Schedule IV	Not spotted

Sl. No.	Zoological names	Common Name	Local Name	IUCN Category	IWPA Category	Field Observation
79	<i>Upupa epops</i>	Common Hoopoe	Chhuangtuar	Least Concern ver 3.1	Schedule IV	Not spotted
80	<i>Yuhina spp.</i>	Yuhina	Ruallubuk	Least Concern ver 3.1	Schedule IV	Spotted in Serchhip and Chhiahtlang
81	<i>Zosterops palpebrosa</i>	Oriental White Eye	Mitval	Least Concern ver 3.1	Schedule IV	Not spotted

## Appendix-7: Results of the Environmental Monitoring Survey

### Air Quality

**Table A7-1 Air Quality in Chhiahtlang in the Dry Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Chhiahtlang Tourist Lodge, N:23°23'41", E:92°50'53" 5 m (approx.) From Edge of the Pavement	01/03/2016 to 02/03/2016	38	18	8	14	< 0.01
	02/03/2016 to 03/03/2016	36	17	7	12	< 0.01
	04/03/2016 to 05/03/2016	39	19	8	13	< 0.01
	05/03/2016 to 06/03/2016	38	17	6	12	< 0.01
Tetie's Tea Stall, Chhiahtlang N:23°22'53", E:92°50'40" 1.5 m (approx.) From Edge of the Pavement	01/03/2016 to 02/03/2016	52	30	10	16	< 0.01
	02/03/2016 to 03/03/2016	50	29	11	17	< 0.01
	04/03/2016 to 05/03/2016	51	31	12	18	< 0.01
	05/03/2016 to 06/03/2016	50	32	10	17	< 0.01
Number of Sample		8	8	8	8	8
Max		52	32	12	18	< 0.01
Min		36	17	6	12	< 0.01
98th Percentile		51	31	11	17	< 0.01

Source: JICA Study Team

**Table A7-2 Air Quality in Chhiahtlang in the Monsoon Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Chhiahtlang Tourist Lodge, N:23°23'41", E:92°50'53" 5 m (approx.) From Edge of the Pavement	16/05/2016 to 17/05/2016	28	17	<5	8	< 0.01
	17/05/2016 to 18/05/2016	27	16	6	9	< 0.01
	19/05/2016 to 20/05/2016	28	17	7	11	< 0.01
	20/05/2016 to 21/05/2016	30	16	<5	7	< 0.01
Tetie's Tea Stall, Chhiahtlang N:23°22'53", E:92°50'40" 1.5 m (approx.) From Edge of the Pavement	16/05/2016 to 17/05/2016	34	18	<5	9	< 0.01
	17/05/2016 to 18/05/2016	29	15	7	8	< 0.01
	19/05/2016 to 20/05/2016	32	17	<5	10	< 0.01
	20/05/2016 to 21/05/2016	31	20	6	11	< 0.01

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Number of Sample		8	8	8	8	8
Max		34	20	7	11	< 0.01
Min		27	15	<5	7	< 0.01
98th Percentile		32	18	7	11	< 0.01

Source: JICA Study Team

**Table A7-3 Air Quality in Serchhip in the Dry Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Aircel Mawiteii Store, New Serchhip N:23°20'51", E:92°50'58" 1.5 m (approx.) From Edge of the Pavement	07/03/2016 to 08/03/2016	50	30	8	13	< 0.01
	08/03/2016 to 09/03/2016	52	26	7	12	< 0.01
	10/03/2016 to 11/03/2016	50	27	8	13	< 0.01
	11/03/2016 to 12/03/2016	51	28	8	14	< 0.01
Hotel Zemela Rooftop, Bazar Area, Serchhip N:23°30'90", E:92°85'67" 10 m (approx.) From Edge of the Pavement	07/03/2016 to 08/03/2016	54	34	9	16	< 0.01
	08/03/2016 to 09/03/2016	56	32	10	17	< 0.01
	10/03/2016 to 11/03/2016	53	33	9	16	< 0.01
	11/03/2016 to 12/03/2016	52	32	9	17	< 0.01
Tajmahal Hotel, Sailiam Kawn, Serchhip N:23°17'24", E:92°51'41" 1.5 m (approx.) From Edge of the Pavement	07/03/2016 to 08/03/2016	56	35	10	15	< 0.01
	08/03/2016 to 09/03/2016	55	34	12	16	< 0.01
	10/03/2016 to 11/03/2016	53	32	11	15	< 0.01
	11/03/2016 to 12/03/2016	54	34	12	17	< 0.01
Number of Sample		12	12	12	12	12
Max		56	35	12	17	< 0.01
Min		50	26	7	12	< 0.01
98th Percentile		56	34	12	17	< 0.01

Source: JICA Study Team

**Table A7-4 Air Quality in Serchhip in the Monsoon Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Aircel Mawiteii Store, New Serchhip N:23°20'51", E:92°50'58" 1.5 m (approx.) From Edge of the Pavement	16/05/2016 to 17/05/2016	37	23	<5	10	< 0.01
	17/05/2016 to 18/05/2016	34	21	8	13	< 0.01
	19/05/2016 to 20/05/2016	32	22	9	14	< 0.01
	20/05/2016 to 21/05/2016	31	24	7	12	< 0.01
Hotel Zemela Rooftop, Bazar Area, Serchhip N:23°30'90", E:92°85'67" 10 m (approx.) From Edge of the Pavement	16/05/2016 to 17/05/2016	36	25	6	12	< 0.01
	17/05/2016 to 18/05/2016	31	24	7	11	< 0.01
	19/05/2016 to 20/05/2016	34	19	7	14	< 0.01
	20/05/2016 to 21/05/2016	38	22	6	14	< 0.01
Tajmahal Hotel, Sailiam Kawn, Serchhip, N:23°17'24", E:92°51'41" 1.5 m (approx.) From Edge of the Pavement	16/05/2016 to 17/05/2016	37	22	<5	9	< 0.01
	17/05/2016 to 18/05/2016	33	20	6	11	< 0.01
	19/05/2016 to 20/05/2016	35	27	8	10	< 0.01
	20/05/2016 to 21/05/2016	34	21	7	8	< 0.01
Number of Sample		12	12	12	12	12
Max		38	27	9	14	< 0.01
Min		31	19	<5	8	< 0.01
98th Percentile		37	25	8	14	< 0.01

Source: JICA Study Team

**Table A7-5 Air Quality in Hnahthial in the Dry Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Samuel Tyre Works, Electric Veng, Hnahthial N:22°58'46", E:92°55'19" 1.5 m (approx.) From Edge of the Pavement	29/02/2016 to 01/03/2016	39	19	7	14	< 0.01
	01/03/2016 to 02/03/2016	37	20	6	13	< 0.01
	03/03/2016 to 04/03/2016	41	18	7	12	< 0.01
	04/03/2016 to 05/03/2016	42	21	6	13	< 0.01
Peniel Veng, Residence of Mr. T SAPTAWNA, H/№. 172, Hnahthial N:22°57'39", E:92°55'44" 1.5 m (approx.) From Edge of the Pavement	29/02/2016 to 01/03/2016	41	22	8	15	< 0.01
	01/03/2016 to 02/03/2016	43	24	9	16	< 0.01
	03/03/2016 to 04/03/2016	44	26	9	15	< 0.01
	04/03/2016 to 05/03/2016	46	23	8	14	< 0.01
Wayside Cottage, Kutkawk, Hnahthial N:22°55'51", E:92°55'33" 5 m (approx.) From Edge of the Pavement	29/02/2016 to 01/03/2016	52	30	7	14	< 0.01
	01/03/2016 to 02/03/2016	49	31	8	15	< 0.01
	03/03/2016 to 04/03/2016	50	32	7	14	< 0.01
	04/03/2016 to 05/03/2016	51	30	8	15	< 0.01
Number of Sample		12	12	12	12	12
Max		52	32	9	16	< 0.01
Min		37	18	6	12	< 0.01
98th Percentile		51	31	9	15	< 0.01

Source: JICA Study Team

**Table A7-6 Air Quality in Hnahthial in the Monsoon Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Samuel Tyre Works, Electric Veng, Hnahthial N:22°58'46", E:92°55'19" 1.5 m (approx.) From Edge of the Pavement	23/05/2016 to 24/05/2016	29	19	8	14	< 0.01
	24/05/2016 to 25/05/2016	32	22	7	9	< 0.01
	26/05/2016 to 27/05/2016	33	17	7	11	< 0.01
	27/05/2016 to 28/05/2016	34	17	6	9	< 0.01
Peniel Veng, Residence of Mr. T SAPTAWNA, H/№. 172, Hnahthial	23/05/2016 to 24/05/2016	31	15	6	12	< 0.01
	24/05/2016 to 25/05/2016	33	18	7	11	< 0.01

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
N:22°57'39", E:92°55'44" 1.5 m (approx.) From Edge of the Pavement	26/05/2016 to 27/05/2016	34	19	6	13	< 0.01
	27/05/2016 to 28/05/2016	32	16	<5	11	< 0.01
Wayside Cottage, Kutkawk, Hnahthial N:22°55'51", E:92°55'33" 5 m (approx.) From Edge of the Pavement	23/05/2016 to 24/05/2016	34	17	7	11	< 0.01
	24/05/2016 to 25/05/2016	31	18	8	9	< 0.01
	26/05/2016 to 27/05/2016	32	16	7	12	< 0.01
	27/05/2016 to 28/05/2016	30	16	6	11	< 0.01
Number of Sample		12	12	12	12	12
Max		34	22	8	14	< 0.01
Min		29	15	6	9	< 0.01
98th Percentile		34	19	8	13	< 0.01

Source: JICA Study Team

**Table A7-7 Air Quality in Lawngtlai in the Dry Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Lawngtlai IV Bazar, N:22°53'37", E:92°89'93" 1.5 m (approx.) From Edge of the Pavement	22/02/2016 to 23/02/2016	58	36	8	15	< 0.01
	23/02/2016 to 24/02/2016	56	34	7	13	< 0.01
	25/02/2016 to 26/02/2016	57	32	9	14	< 0.01
	26/02/2016 to 27/02/2016	59	33	7	15	< 0.01
AOC Veng, Lawngtlai, N:22°53'38", E:92°89'93" 1.5 m (approx.) From Edge of the Pavement	22/02/2016 to 23/02/2016	62	38	9	16	< 0.01
	23/02/2016 to 24/02/2016	57	37	7	15	< 0.01
	25/02/2016 to 26/02/2016	55	36	8	15	< 0.01
	26/02/2016 to 27/02/2016	59	41	7	14	< 0.01
Number of Sample		8	8	8	8	8
Max		62	41	9	16	< 0.01
Min		55	32	7	13	< 0.01
98th Percentile		59	38	9	15	< 0.01

Source: JICA Study Team



**Table A7-8 Air Quality in Lawngtlai in the Monsoon Season**

Sampling Location:	Date of Sampling	Parameters				
		Particulate Matter (PM <sub>10</sub> ) in µg/Nm <sup>3</sup>	Particulate Matter (PM <sub>2.5</sub> ) in µg/Nm <sup>3</sup>	Sulphur Dioxide (SO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Nitrogen Dioxide (NO <sub>2</sub> ) in µg/Nm <sup>3</sup>	Lead (Pb) in µg/Nm <sup>3</sup>
Lawngtlai IV Bazar, N:22°53'37", E:92°89'93" 1.5 m (approx.) From Edge of the Pavement	23/05/2016 to 24/05/2016	32	20	8	12	< 0.01
	24/05/2016 to 25/05/2016	30	18	7	11	< 0.01
	26/05/2016 to 27/05/2016	29	21	7	9	< 0.01
	27/05/2016 to 28/05/2016	31	20	6	10	< 0.01
AOC Veng, Lawngtlai, N:22°53'38", E:92°89'93" 1.5 m (approx.) From Edge of the Pavement	23/05/2016 to 24/05/2016	33	22	8	14	< 0.01
	24/05/2016 to 25/05/2016	35	21	7	9	< 0.01
	26/05/2016 to 27/05/2016	32	21	6	11	< 0.01
	27/05/2016 to 28/05/2016	30	23	7	12	< 0.01
Number of Sample		8	8	8	8	8
Max		35	23	8	14	< 0.01
Min		29	18	6	9	< 0.01
98th Percentile		32	22	8	12	< 0.01

Source: JICA Study Team

## Water Quality

**Table A7-9 Surface Water Quality in Chhiahtlang in the Dry Season**

LOCATION: CHHIAHTLANG			24/2/2016 and 5/3/2016					LIMIT IS:10500: 2012
SL. NO.	Parameters	Unit	Sample 1 Water Tank	Sample 2 Ground Water	Sample 3 Ground Water	Sample 4 Ground Water	Sample 5 Surface Water	
1	Color	Hazen unit	1	1	1	1	1	5
2	Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	6.7	7.1	7.1	7.4	7.4	6.5 - 8.5
6	Temperature (°C)	Celsius	20.1 °C	19.6 °C	19 °C	19.5 °C	19 °C	-
7	Total Suspended Solids	mg/l	69	263	295	155	131	-
8	Total Dissolved Solids	mg/l	200	350	450	90	270	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.18	0.41	0.56	0.03	0.42	-
12	Alkalinity	mg/l	35	60	120	45	35	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	34	55	51	47	49	200
15	Chloride as (Cl)	mg/l	12.5	22.5	15	-	5	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	14.4	22.2	25.5	7.7	15.5	75
18	Magnesium as Mg	mg/l	6.9	9.2	10.4	4.5	6.8	30
19	Fluoride as F	mg/l	<1	<1	<1	<1	<1	1
20	Nitrate as NO <sub>3</sub>	mg/l	10	13	12	3	4	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	7.21	5.46	5.48	5.96	5.37	200
22	Iron (Fe)	mg/l	0.16	0.28	0.26	0.29	0.15	0.3
23	Total <i>Coliform</i> (MPN/100 ml)	MPN/100 ml	48	Absent	Absent	Absent	9	Absent

Note: <1 indicates no colony developed in 1 ml sample  
 <10 indicates no colony developed in 0.1 ml sample  
 <100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

**Table A7-10 Surface Water Quality in Chhiahtlang in the Monsoon Season**

LOCATION: CHHIAHTLANG			17/05/2016, 18/05/2016, 09/07/2016 and 12/07/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Water Tank	Sample 2 Ground Water	Sample 3 Ground Water	Sample 4 Ground Water	Sample 5 Surface Water	

LOCATION: CHHIAHTLANG			17/05/2016, 18/05/2016, 09/07/2016 and 12/07/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Water Tank	Sample 2 Ground Water	Sample 3 Ground Water	Sample 4 Ground Water	Sample 5 Surface Water	
1	Color	Hazen unit	1	1	1	1	1	5
2	Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	6.4	7.1	7.9	7.3	6.8	6.5 - 8.5
6	Temperature (°C)	Celsius	25.1 °C	26.6 °C	27 °C	26.5 °C	26.7 °C	-
7	Total Suspended Solids	mg/l	162	120	62	75	107	-
8	Total Dissolved Solids	mg/l	114	84	103	58	139	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.68	0.64	0.77	0.48	0.51	-
12	Alkalinity	mg/l	30	41	45	40	38	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	Nil	168	8	Nil	40	200
15	Chlorides as (Cl)	mg/l	26	32	20	24	94	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	20	24	22	14	34	75
18	Magnesium as Mg	mg/l	8.5	8	9	18.5	7.5	30
19	Fluoride as F	mg/l	BDL	BDL	BDL	BDL	BDL	1
20	Nitrate as NO <sub>3</sub>	mg/l	8	9	10	4	6	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	4.5	3.4	6.2	4.9	4.3	200
22	Iron (Fe)	mg/l	0.3	0.3	0.3	0.2	0.2	0.3
23	Total Coliform (MPN/100 ml)	MPN/100 ml	Absent	Absent	Absent	Absent	300	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

**Table A7-11 Surface Water Quality in Serchhip in the Dry Season**

LOCATION: SERCHHIP			24/2/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 C Water Tank	Sample 2 Surface Water	Sample 3 Potable Water	Sample 4 Stream Water	Sample 1 C Water Tank	
1	Color	Hazen unit	1	1	1	1	1	5
2	Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable

LOCATION: SERCHHIP			24/2/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 C Water Tank	Sample 2 Surface Water	Sample 3 Potable Water	Sample 4 Stream Water	Sample 1 C Water Tank	
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	8.1	8.3	7.2	7.1	8.1	6.5 - 8.5
6	Temperature (°C)	Celsius	27.6 °C	26.1 °C	27.4 °C	26.5 °C	27.6 °C	-
7	Total Suspended Solids	mg/l	55	127	35	116	55	-
8	Total Dissolved Solids	mg/l	108	134	89	93	108	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.32	0.19	0.42	0.56	0.32	-
12	Alkalinity	mg/l	28	32	22	25	28	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	44	28	24	Nil	44	200
15	Chlorides as (Cl)	mg/l	34	28	22	26	34	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	36	32	18	14	36	75
18	Magnesium as Mg	mg/l	19.5	18	12.5	14.5	19.5	30
19	Fluoride as F	mg/l	BDL	BDL	BDL	BDL	BDL	1
20	Nitrate as NO <sub>3</sub>	mg/l	10	10	8	7	10	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	5.9	5.5	4.9	3.6	5.9	200
22	Iron (Fe)	mg/l	0.2	0.3	0.3	0.3	0.2	0.3
23	Total <i>Coliform</i> (MPN/100 ml)	MPN/100 ml	Absent	Absent	Absent	Absent	Absent	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample  
Source: JICA Study Team

**Table A7-12 Surface Water Quality in Serchhip in the Monsoon Season**

LOCATION: SERCHHIP			9/7/2016 and 17/05/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 C Water Tank	Sample 2 Surface Water	Sample 3 Potable Water	Sample 4 Stream Water	Sample 1 C Water Tank	
1	Colour	Hazen unit	Clear	Clear	Clear	Clear	Clear	5
2	Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1

LOCATION: SERCHHIP			9/7/2016 and 17/05/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 C Water Tank	Sample 2 Surface Water	Sample 3 Potable Water	Sample 4 Stream Water	Sample 1 C Water Tank	
5	pH	value	8.1	8.3	7.2	7.1	8.1	6.5 - 8.5
6	Temperature (°C)	Celsius	27.6 °C	26.1 °C	27.4 °C	26.5 °C	27.6 °C	-
7	Total Suspended Solids	mg/l	55	127	35	116	55	-
8	Total Dissolved Solids	mg/l	108	134	89	93	108	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.32	0.19	0.42	0.56	0.32	-
12	Alkalinity	mg/l	28	32	22	25	28	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	44	28	24	Nil	44	200
15	Chloride as (Cl)	mg/l	34	28	22	26	34	250
16	Residual Free Chlorine	mg/l	< 1	< 1	< 1	< 1	< 1	0.2
17	Calcium as Ca	mg/l	36	32	18	14	36	75
18	Magnesium as Mg	mg/l	19.5	18	12.5	14.5	19.5	30
19	Fluoride as F	mg/l	BDL	BDL	BDL	BDL	BDL	1
20	Nitrate as NO <sub>3</sub>	mg/l	10	10	8	7	10	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	5.9	5.5	4.9	3.6	5.9	200
22	Iron (Fe)	mg/l	0.2	0.3	0.3	0.3	0.2	0.3
23	Total Coliform (MPN/100 ml)	MPN/100 ml	Absent	Absent	Absent	Absent	Absent	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

**Table A7-13 Surface Water Quality in Hnahthial in the Dry Season**

LOCATION: HNAHTHIAL			23/2/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
1	Colour	Hazen unit	1	1	1	1	1	5
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	7	7.7	6.8	7.2	7	6.5 - 8.5
6	Temperature	Celsius	18.1 °C	19 °C	18.6 °C	19 °C	18.1 °C	-

LOCATION: HNAHTHIAL			23/2/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
	( °C )							
7	Total Suspended Solids	mg/l	137	157	186	258	137	-
8	Total Dissolved Solids	mg/l	160	230	168	140	160	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.12	0.23	0.13	0.11	0.12	-
12	Alkalinity	mg/l	45	45	40	45	45	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	56	18	36	32	56	200
15	Chloride as (Cl)	mg/l	2.5	-	-	5	2.5	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	18.8	21.1	17.7	18.8	18.8	75
18	Magnesium as Mg	mg/l	9.2	9.6	7.8	8.2	9.2	30
19	Fluoride as F	mg/l	<1	<1	<1	<1	<1	1
20	Nitrate as NO <sub>3</sub>	mg/l	10	12	8	9	10	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	3.69	6.25	5.84	6.76	3.69	200
22	Iron (Fe)	mg/l	0.16	0.22	0.25	0.21	0.16	0.3
23	Total Coliform (MPN/100 ml)	MPN/100 ml	910	32	Absent	Absent	910	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

**Table A7-14 Surface Water Quality in Hnahthial in the Monsoon Season**

LOCATION: HNAHTHIAL			25/5/2016 and 8/7/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
1	Color	Hazen unit	1	1	1	1	1	5
2	Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	6.8	7.7	6.3	8.2	6.8	6.5 - 8.5
6	Temperature ( °C )	Celsius	26.1 °C	27 °C	26.6 °C	26.8 °C	26.1 °C	-
7	Total Suspended	mg/l	116	98	108	88	116	-

LOCATION: HNAHTHIAL			25/5/2016 and 8/7/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
	Solids							
8	Total Dissolved Solids	mg/l	120	95	114	97	120	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.42	0.37	0.29	0.81	0.42	-
12	Alkalinity	mg/l	32	36	28	25	32	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	Nil	50	30	20	Nil	200
15	Chloride as (Cl)	mg/l	18	24	24	28	18	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	26	32	24	26	26	75
18	Magnesium as Mg	mg/l	9.5	8	10	12.5	9.5	30
19	Fluoride as F	mg/l	BDL	BDL	BDL	BDL	BDL	1
20	Nitrate as NO <sub>3</sub>	mg/l	7	8	10	6	7	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	7.1	6.1	6.7	7.7	7.1	200
22	Iron (Fe)	mg/l	0.2	0.2	0.3	0.2	0.2	0.3
23	Total Coliform (MPN/100 ml)	MPN/100 ml	200	Absent	Absent	Absent	200	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

**Table A7-15 Surface Water Quality in Lawngtlai in the Dry Season**

LOCATION: LAWNGTLAI			23/2/2016 and 29/2/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
1	Colour	Hazen unit	1	1	1	1	1	5
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	7.1	7.3	6.7	6.9	7.1	6.5 - 8.5
6	Temperature (°C)	Celsius	18.6 °C	19.2 °C	20.5 °C	19.8 °C	18.6 °C	-
7	Total Suspended Solids	mg/l	238	56	119	264	238	-
8	Total Dissolved Solids	mg/l	90	80	100	510	90	500

LOCATION: LAWNGTLAI			23/2/2016 and 29/2/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-
11	Conductivity	µS/cm	0.94	0.93	0.93	1.57	0.94	-
12	Alkalinity	mg/l	45	55	45	40	45	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	30	47	48	38	30	200
15	Chloride as (Cl)	mg/l	5	5	7.5	5	5	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	16.6	15.5	16.6	6.9	16.6	75
18	Magnesium as Mg	mg/l	8.5	6.9	8.6	3.5	8.5	30
19	Fluoride as F	mg/l	<1	<1	<1	<1	<1	1
20	Nitrate as NO <sub>3</sub>	mg/l	8	9	10	7	8	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	7.25	6.42	5.76	5.48	7.25	200
22	Iron (Fe)	mg/l	0.27	0.18	0.22	0.14	0.27	0.3
23	Total <i>Coliform</i> (MPN/100 ml)	MPN/100 ml	Absent	Absent	Absent	151	Absent	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

**Table A7-16 Surface Water Quality in Lawngtlai in the Monsoon Season**

LOCATION: LAWNGTLAI			23/5/2016 and 7/7/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
1	Colour	Hazen unit	1	1	1	1	1	5
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity in NTU	NTU	1	1	1	1	1	1
5	pH	value	6.5	6.8	6.6	7.8	6.5	6.5 - 8.5
6	Temperature (°C)	Celsius	26.6 °C	27.2 °C	26.5 °C	27.8 °C	26.6 °C	-
7	Total Suspended Solids	mg/l	92	127	126	156	92	-
8	Total Dissolved Solids	mg/l	78	94	87	102	78	500
9	BOD in mg/l (5 days 20 °C)	mg/l	< 1	< 1	< 1	< 1	< 1	-
10	COD in mg/l	mg/l	< 1	< 1	< 1	< 1	< 1	-



LOCATION: LAWNGTLAI			23/5/2016 and 7/7/2016					LIMIT IS:10500: 2012
SL. No.	Parameters	Unit	Sample 1 Surface Water	Sample 2 C Water Tank	Sample 3 C Water Tank	Sample 4 C Water Tank	Sample 1 Surface Water	
11	Conductivity	µS/cm	0.53	0.37	0.28	0.64	0.53	-
12	Alkalinity	mg/l	26	30	25	34	26	200
13	Oil and Grease	mg/l	< 1	< 1	< 1	< 1	< 1	-
14	Total Hardness CaCO <sub>3</sub>	mg/l	<1	<1	4	<1	<1	200
15	Chloride as (Cl)	mg/l	28	24	58	26	28	250
16	Residual Free Chlorine	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
17	Calcium as Ca	mg/l	16	10	22	14	16	75
18	Magnesium as Mg	mg/l	8	9	7	11	8	30
19	Fluoride as F	mg/l	BDL	BDL	BDL	BDL	BDL	1
20	Nitrate as NO <sub>3</sub>	mg/l	12	10	10	5	12	45
21	Sulphates as (SO <sub>4</sub> )	mg/l	6.5	6.8	5.4	7.9	6.5	200
22	Iron (Fe)	mg/l	0.2	2	0.3	0.2	0.2	0.3
23	Total <i>Coliform</i> (MPN/100 ml)	MPN/100 ml	Absent	Absent	Absent	400	Absent	Absent

Note: <1 indicates no colony developed in 1 ml sample  
<10 indicates no colony developed in 0.1 ml sample  
<100 indicates no colony developed in 0.01 ml sample

Source: JICA Study Team

## Noise

**Table A7-17 Noise Level in Chhiahtlang in the Dry Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>	L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>
1	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	1/03/2016 to 2/03/2016	50.3	65.4	61.5	35.5	48.9	44.2
2	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	1/03/2016 to 2/03/2016	51.8	68	61.4	40.8	47.8	45.4
3	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	2/03/2016 to 3/03/2016	47.6	58.2	54.7	37.5	47.9	44.0
4	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	2/03/2016 to 3/03/2016	49.3	68	60.3	41.8	52.0	47.8
5	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	4/03/2016 to 5/03/2016	45.8	58.5	55.9	38.8	46.0	43.0
6	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	4/03/2016 to 5/03/2016	47.2	64	58.7	40.9	51.7	46.8
7	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	5/03/2016 to 6/03/2016	46.1	60.7	57.5	39.4	47.1	44.2
8	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	5/03/2016 to 6/03/2016	46.7	68	59.6	41.2	49.8	46.3
Minimum				45.8	58.2	54.7	35.5	46.0	43.0
Maximum				51.8	68.0	61.5	41.8	52.0	47.8

Source: JICA Study Team

**Table A7-18 Noise Level in Chhiahtlang in the Monsoon Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>	L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>
1	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	16/05/2016 to 17/05/2016	51.2	64.5	63.2	36.5	44.9	43.8
2	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	17/05/2016 to 18/05/2016	48.2	56.5	55.3	38.6	46.2	45.1
3	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	19/05/2016 to 20/05/2013	46.2	56.6	55.8	39.2	43.9	42.9
4	CHHIAHTLANG 1, Tourist Lodge	N:23°23'41" E:92°50'53"	20/05/2016 to 21/05/2016	47.5	61.2	58.3	39.3	44.9	43.1
5	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	16/05/2016 to 17/05/2016	52.9	62.5	60.3	37.2	45.9	44.4
6	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	17/05/2016 to 18/05/2016	48.9	60.1	58.6	38.8	47.1	43.3
7	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	19/05/2016 to 20/05/2013	47.6	60.9	58.1	41.5	45.4	43.9

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>	L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>
8	CHHIAHTLANG 2, Tetei's Tea Stall	N:23°22'53" E:92°50'40"	20/05/2016 to 21/05/2016	47.2	60.2	58.3	40.3	47.5	47.2
Minimum				46.2	56.5	55.3	36.5	43.9	42.9
Maximum				52.9	64.5	63.2	41.5	47.5	47.2

Source: JICA Study Team

**Table A7-19 Noise Level in Serchhip in the Dry Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>	L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>
1	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	07/03/2016 to 08/03/2016	54.6	65.7	62.2	42.3	53.7	49.6
2	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	07/03/2016 to 08/03/2016	55.7	70.6	63.5	45.8	58.5	52.5
3	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	07/03/2016 to 08/03/2016	53.5	68.6	62.2	46.5	58.5	52.5
4	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	08/03/2016 to 09/03/2016	53.4	66.5	61.7	44.2	53.7	50.4
5	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	08/03/2016 to 09/03/2016	57.5	68.1	63.8	45.8	56.5	51.6
6	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	08/03/2016 to 09/03/2016	55.7	71.6	63.0	47.2	54.5	51.1
7	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	10/03/2016 to 11/03/2013	54.5	68.5	61.9	44.6	54.1	51.1
8	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	10/03/2016 to 11/03/2013	55.9	72.0	64.5	46.5	58.5	52.5
9	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	10/03/2016 to 11/03/2013	57.3	69.6	62.9	46.5	58.5	52.5
10	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	11/03/2016 to 12/03/2016	55.2	70.5	62.6	46.2	56.1	52.2
11	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	11/03/2016 to 12/03/2016	56.9	71.0	64.2	47.2	53.1	50.7
12	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	11/03/2016 to 12/03/2016	58.1	68.6	62.7	49.3	55.8	52.7
Minimum				53.4	65.7	61.7	42.3	53.1	49.6
Maximum				58.1	72.0	64.5	49.3	58.5	52.7

Source: JICA Study Team

**Table A7-20 Noise Level in Serchhip in the Monsoon Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	Leq	L <sub>min</sub>	L <sub>max</sub>	Leq
1	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	16/05/2016 to 17/05/2016	55.2	70.7	67.2	43.2	52.4	50.1
2	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	17/05/2016 to 18/05/2016	53.8	65.4	59.5	37.8	46.3	45.1
3	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	19/05/2016 to 20/05/2013	55.5	65.5	60.8	40.7	46.8	42.1
4	SERCHHIP 1, Aircel Mawiteii Store	N:23°20'51" E:92°50'58"	20/05/2016 to 21/05/2016	56.5	68.3	61.6	45.8	55.5	52.8
5	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	16/05/2016 to 17/05/2016	56.8	69.5	67.1	46.8	57.3	53.1
6	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	17/05/2016 to 18/05/2016	58.2	66.5	60.2	46.3	57.2	52.7
7	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	19/05/2016 to 20/05/2013	56.9	70.5	65.5	45.3	57.2	53.1
8	SERCHHIP 2, Hotel Zamela Rooftop	N:23°30'90" E:92°85'67"	20/05/2016 to 21/05/2016	55.8	70.2	60.5	46.5	53.4	51.4
9	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	16/05/2016 to 17/05/2016	54.2	73.5	72.1	47.3	57.8	51.6
10	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	17/05/2016 to 18/05/2016	54.5	68.5	67.1	46.5	55.5	52.3
11	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	19/05/2016 to 20/05/2013	56.8	67.5	65.2	47.2	47.3	46.8
12	SERCHHIP 3, Taj Mahal Hotel	N:23°17'24" E:92°51'41"	20/05/2016 to 21/05/2016	57.8	67.6	64.5	42.9	44.7	45.3
Minimum				53.8	65.4	59.5	37.8	44.7	42.1
Maximum				58.2	73.5	72.1	47.3	57.8	53.1

Source: JICA Study Team

**Table A7-21 Noise Level in Hnahtial in the Dry Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	Leq	L <sub>min</sub>	L <sub>max</sub>	Leq
1	HNAHTHIAL 1, Wayside Cottage	N:22°55 '51" E:92°55'33"	29/02/2016 and 01/03/2016	42.5	62.4	55.3	34.6	51.0	46.0
2	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	29/02/2016 and 01/03/2016	40.2	70.2	59.6	32.5	53.0	46.0
3	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	29/02/2016 and 01/03/2016	41.2	68.0	59.3	39.5	49.5	44.7

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	Leq	L <sub>min</sub>	L <sub>max</sub>	Leq
4	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	01/03/2016 and 02/03/2016	44.0	65.0	57.5	32.0	46.5	43.2
5	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	01/03/2016 and 02/03/2016	40.6	71.2	61.9	34.6	56.3	49.7
6	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	01/03/2016 and 02/03/2016	42.6	70.2	61.7	30.2	54.5	46.6
7	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	03/03/2016 and 04/03/2016	46.4	68.2	59.9	34.0	48.6	45.9
8	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	03/03/2016 and 04/03/2016	41.8	68.7	60.0	35.5	55.3	49.8
9	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	03/03/2016 and 04/03/2016	43.1	69.2	61.5	31.6	55.5	47.4
10	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	04/03/2016 and 05/03/20	45.2	67.0	58.9	35.0	49.6	45.1
11	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	04/03/2016 and 05/03/20	48.4	72.6	62.1	32.2	52.3	48.0
12	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	04/03/2016 and 05/03/20	40.6	71.2	61.2	33.4	62.1	53.4
Minimum				40.2	62.4	55.3	30.2	46.5	43.2
Maximum				48.4	72.6	62.1	39.5	62.1	53.4

Source: JICA Study Team

**Table A7-22 Noise Level in Hnahthial in the Monsoon Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	Leq	L <sub>min</sub>	L <sub>max</sub>	Leq
1	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	23/05/2016 and 24/05/2016	43.5	60.5	59.3	35.9	41.6	40.2
2	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	24/05/2016 and 25/05/2016	45.2	62.3	61.4	32.5	47.2	44.6
3	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	26/05/2016 and 27/05/2016	46.2	64.5	63.7	34.6	46.2	44.8
4	HNAHTHIAL 1, Wayside Cottage	N:22°55'51" E:92°55'33"	27/05/2016 and 28/02/2016	44.6	64.6	63.9	35.4	47.7	44.5
5	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	23/05/2016 and 24/05/2016	41.8	70.3	68.7	34.3	41.4	40.4
6	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	24/05/2016 and 25/05/2016	42.5	65.8	63.4	35.2	48.2	47.4
7	HNAHTHIAL	N:22°58'45"	26/05/2016	42.8	66.5	63.2	36.4	48.5	47.2

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	Leq	L <sub>min</sub>	L <sub>max</sub>	Leq
	2, Samuel Tyre Works	E:92°55'19"	and 27/05/2016						
8	HNAHTHIAL 2, Samuel Tyre Works	N:22°58'45" E:92°55'19"	27/05/2016 and 28/02/2016	49.3	68.5	59.5	33.2	53.1	47.6
9	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	23/05/2016 and 24/05/2016	42.9	65.2	63.4	39.6	46.4	44.7
10	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	24/05/2016 and 25/05/2016	43.5	65.3	59.2	32.5	52.3	48.4
11	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	26/05/2016 and 27/05/2016	42.6	66.2	64.2	32.5	47.9	46.5
12	HNAHTHIAL 3, Peniel Veng	N:22°57'39" E:92°55'44"	27/05/2016 and 28/02/2016	41.5	68.3	67.2	33.5	48.5	46.5
Minimum				41.5	60.5	59.2	32.5	41.4	40.2
Maximum				49.3	70.3	68.7	39.6	53.1	48.4

Source: JICA Study Team

**Table A7-23 Noise Level in Lawngtlai in the Dry Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	Leq	L <sub>min</sub>	L <sub>max</sub>	Leq
1	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	22/02/2016 and 23/02/2016	54.3	70.0	61.5	46.2	50.7	48.2
2	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	22/02/2016 and 23/02/2016	56.3	70	63.6	47.4	52.9	50.1
3	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	23/02/2016 and 24/02/2016	54.7	72	64.0	48.9	56.0	52.4
4	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	23/02/2016 and 24/02/2016	60.1	72.6	65.4	49.1	55.8	52.4
5	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	25/02/2016 and 26/02/2016	52.4	68.4	62.2	45.1	54.3	50.5
6	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	25/02/2016 and 26/02/2016	57.7	70	64.3	50.2	59.9	55.3
7	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	26/02/2016 and 27/02/2016	53.6	72	64.8	50.3	56.7	54.1
8	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	26/02/2016 and 27/02/2016	59.4	66.9	64.0	51.7	61.4	56.8
Minimum				52.4	66.9	61.5	45.1	50.7	48.2
Maximum				60.1	72.6	65.4	51.7	61.4	56.8

Source: JICA Study Team

**Table A7-24 Noise Level in Lawngtlai in the Monsoon Season**

Sl. No.	Sampling Location	GPS Coordinates	Sampling Date	Ambient Noise Level Leq.dB(A)					
				Day Time (06:00AM to 10:00PM)			Night Time (10:00PM to 06:00AM)		
				L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>	L <sub>min</sub>	L <sub>max</sub>	L <sub>eq</sub>
1	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	23/05/2016 and 24/05/2016	54.1	60.4	56.3	45.2	50	47.2
2	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	24/05/2016 and 25/05/2016	55.7	62.3	58.2	43.5	47.0	46.0
3	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	26/05/2016 and 27/05/2016	54.3	62.1	58.1	40.3	47	48.5
4	LAWNGTLAI 1, Lawngtlai Bazar	N:22°31'41" E:92°53'49"	27/05/2016 and 28/02/2016	54.5	62.8	61.2	40.8	46	43.4
5	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	23/05/2016 and 24/05/2016	55.3	67.2	64.7	47.2	51	50.1
6	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	24/05/2016 and 25/05/2016	60.5	70.6	68.4	40.4	47	43.6
7	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	26/05/2016 and 27/05/2016	57.5	65.6	64.3	41.3	49	46.2
8	LAWNGTLAI 2, AOC Veng	N:22°32'20" E:92°53'11"	27/05/2016 and 28/02/2016	58.7	70.3	63.3	52.7	55	54.5
Minimum				54.1	60.4	56.3	40.3	46.0	43.4
Maximum				60.5	70.6	68.4	52.7	55.0	54.5

Source: JICA Study Team

## Vibration

**Table A7-25 Vibration Level in Chhiahtlang in the Dry Season**

Sampling Station	Start Point E: 23°23'41", N: 92°50'53" 2 m (approx.) (From Edge of the Pavement)				End Point E:23°22'42", N: 92°50'36" 1.5 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	01/03/2016 and 02/03/2016	02/03/2016 and 03/03/2016	04/03/2016 and 05/03/2016	05/03/2016 and 06/03/2016	01/03/2016 and 02/03/2016	02/03/2016 and 03/03/2016	04/03/2016 and 05/03/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	1.95	106	1.5	104	1.98	106	1.50	104
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

**Table A7-26 Vibration Level in Chhiahtlang in the Monsoon Season**

Sampling Station	Start Point E: 23°23'41", N: 92°50'53" 2 m (approx.) (From Edge of the Pavement)				End Point E:23°22'53", N: 92°50'38" 1.5 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	16/05/2016 and 17/05/2016	17/05/2016 and 18/05/2016	19/05/2016 and 20/05/2016	20/05/2016 and 21/05/2016	16/05/2016 and 17/05/2016	17/05/2016 and 18/05/2016	19/05/2016 and 20/05/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	1.88	105	0.11	81	1.87	105	0.15	84
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

**Table A7-27 Vibration Level in Serchhip in the Dry Season**

Sampling Station	Start Point AircelMawiteii Store, New Serchhip N:23°20'51", E:92°50'58" 1.5 m (approx.) (From Edge of the Pavement)				End Point Tajmahal Hotel, SailiamKawn, Serchhip N:23°17'24" E:92°51'41" 1.5 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	07/03/2016 to 08/03/2016	08/03/2016 to 09/03/2016	10/03/2016 to 11/03/2016	11/03/2016 to 12/03/2016	07/03/2016 to 08/03/2016	08/03/2016 to 09/03/2016	10/03/2016 to 11/03/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	2.35	107	0.02	66	1.98	106	0.02	66
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team



**Table A7-28 Vibration Level in Serchhip in the Monsoon Season**

Sampling Station	Start Point AircelMawiteii Store, New Serchhip N:23°20'51", E:92°50'58" 1.5 m (approx.) (From Edge of the Pavement)				End Point Tajmahal Hotel, SailiamKawn, Serchhip N:23°17'24" E:92°51'41" 1.5 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	16/05/2016 and 17/05/2016	17/05/2016 and 18/05/2016	19/05/2016 and 20/05/2016	20/05/2016 and 21/05/2016	16/05/2016 and 17/05/2016	17/05/2016 and 18/05/2016	19/05/2016 and 20/05/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	2.12	107	0.08	78	1.98	106	0.05	74
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

**Table A7-29 Vibration Level in Hnahthial in the Dry Season**

Sampling Station	Start Point Wayside Cottage, Kutkaw, Hnahthial E:22°58'45", N: 92°55'18" 1.5 m (approx.) (From Edge of the Pavement)				End Point (Highway Inn Hnahthial) E:22°55'50", N: 92°55'33" 2 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	29/02/2016 and 01/03/2016	01/03/2016 and 02/03/2016	03/03/2016 and 04/03/2016	04/03/2016 and 05/03/2016	29/02/2016 and 01/03/2016	01/03/2016 and 02/03/2016	03/03/2016 and 04/03/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	1.60	104	0.5	94	1.74	105	0.38	92
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

**Table A7-30 Vibration Level in Hnahthial in the Monsoon Season**

Sampling Station	Start Point Samuel Tyre Works, Electric Veng, Hnahthial N:22°58'46", E:92°55'19" 1.5 m (approx.) (From Edge of the Pavement)				End Point ( Highway Inn Hnahthial) E:22°55'50", N: 92°55'33" 2 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	23/05/2016 and 24/05/2016	24/05/2016 and 25/05/2016	26/05/2016 and 27/05/2016	27/05/2016 and 28/05/2016	23/05/2016 and 24/05/2016	24/05/2016 and 25/05/2016	26/05/2016 and 27/05/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	1.92	106	0.28	89	1.58	104	0.56	95
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

**Table A7-31 Noise Level in Lawngtlai in the Dry Season**

Sampling Station	Lawngtlai Bazar, E:22°31'40", N: 92°53'49" 1.5 m (approx.) (From Edge of the Pavement)				AOC Veng E:22°32'19", N: 92°53'11" 1.5 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	22/02/2016 and 23/02/2016	23/02/2016 to 24/02/2016	25/02/2016 to 26/02/2016	26/02/2016 to 27/02/2016	22/02/2016 and 23/02/2016	23/02/2016 to 24/02/2016	25/02/2016 to 26/02/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	1.85	105	0.02	66	1.68	104	0.02	66
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

**Table A7-32 Vibration Level in Lawngtlai in the Monsoon Season**

Sampling Station	AOC Veng E:22°32'19", N: 92°53'12" 1.5 m (approx.) (From Edge of the Pavement)				Lawngtlai Bazar E:22°31'41", N: 92°53'50" 1.5 m (approx.) (From Edge of the Pavement)			
	Date of Sampling	23/05/2016 and 24/05/2016	24/05/2016 to 25/05/2016	26/05/2016 to 27/05/2016	27/05/2016 to 28/05/2016	23/05/2016 and 24/05/2016	24/05/2016 to 25/05/2016	26/05/2016 to 27/05/2016
Duration	Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr		Day Time 6 hr – 22 hr		Night Time 22 hr- 6 hr	
Unit	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB	mm/sec (rms)	VdB
Maximum	1.98	106	0.43	93	1.86	105	0.78	98
Minimum	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60	< 0.01	< 60

Source: JICA Study Team

## Appendix-8-1: Environmental Monitoring Form

### Monitoring during Supervision

Observation of the construction/operation works to ensure mitigation actions will be conducted during site inspections as routine supervision of the work. This work will be conducted as part of general operation working/maintenance progress including daily work. Draft monitoring forms for each stage of the project are shown below.

### **Form 1-1: Monitoring Form during Planning/Design Stage for NH54 Bypasses**

Monitoring Period From     Date    Month    Year      
To     Date    Month    Year    

S.N.	Items	Check Point	Frequency	Evaluation or Mitigation status Y: Good / Yes N: Poor / No	Remark And Signature by Checker
1	Social impact	- Check notification	<input type="checkbox"/> Monthly/ <input type="checkbox"/> Quarterly/ <input type="checkbox"/> Bi-annually	<input type="checkbox"/> Y / <input type="checkbox"/> N	Signature by inspector
		- Check payment record	<input type="checkbox"/> Monthly/ <input type="checkbox"/> Quarterly/ <input type="checkbox"/> Bi-annually	<input type="checkbox"/> Y / <input type="checkbox"/> N	
2	Crops and vegetation	- Interviews with local residents will also help in this matter.	<input type="checkbox"/> Before commencement date	<input type="checkbox"/> Y / <input type="checkbox"/> N	
3	Impacts on ROW design	- Check final design drawing and original plan	<input type="checkbox"/> Before the commencement of construction activities	<input type="checkbox"/> Y / <input type="checkbox"/> N	
4	Noise and vibration	- Determination of critical sites and methods of mitigation during the construction period	<input type="checkbox"/> Monthly/ <input type="checkbox"/> As necessary	<input type="checkbox"/> Y / <input type="checkbox"/> N	
5	Water quality	- Check final planning and approve if proposal is suitable	<input type="checkbox"/> Before the commencement of construction activities	<input type="checkbox"/> Y / <input type="checkbox"/> N	
6	Land slide and soil erosion	- Visit site and check land plans, alignment	<input type="checkbox"/> Site visits <input type="checkbox"/> once after monsoon	<input type="checkbox"/> Y / <input type="checkbox"/> N	
7	Loss of or damage to Religious places and eco-sensitive areas.	- Check encroachment on religious areas	<input type="checkbox"/> Before and during construction phase	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Check eco-sensitive areas	<input type="checkbox"/> Before construction phase	<input type="checkbox"/> Y / <input type="checkbox"/> N	
Total				Yes <u>    </u> No	

**Form 1-2: Monitoring Form during Construction Stage**

Type of work:

Monitoring Season:  Pre-monsoon /  Post-monsoon /  Winter

Monitoring Period From                 
 To               

S.N.	Items	Check Point	Frequency	Evaluation or Mitigation status Y: Good / Yes N: Poor / No	Remark And Signature by Checker
1	Social impact	- Check if the community has brought the problem to the notice of the Consultant and Client	<input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	Signature by Inspector
2	Air pollution	- Check watering as per the frequency given in the EMP.	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Proper implementation can be achieved by site inspection along with interviews with local residents.	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Seasonal monitoring	<input type="checkbox"/> Seasonal	As per Form C1-4	
3	Noise and vibration	- Check that the Contractor is performing mitigation measures.	<input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- This can be achieved by interviewing the locals and site inspection.	<input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Seasonal monitoring	<input type="checkbox"/> Seasonal	As per Form C1-5	
4	Water quality	- Visit site and check drain provision/functioning	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Seasonal monitoring	<input type="checkbox"/> Seasonal	As per Form C1-6, 7	
5	Oil spills and hazardous wastes	- Check the mitigation measures.	<input type="checkbox"/> One check	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- A fortnightly inspection is necessary until the completion of the project.	<input type="checkbox"/> One check	<input type="checkbox"/> Y / <input type="checkbox"/> N	
6	Spoil disposal	- A monthly inspection of the disposal sites along with the review of the design plan is a better way of assessment.	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	

S.N.	Items	Check Point	Frequency	Evaluation or Mitigation status Y: Good / Yes N: Poor / No	Remark And Signature by Checker
7	Construction waste disposal	- Interviews with local residents will also give a proper assessment of the issue.	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
8	Land slide and soil erosion	- A site inspection along with the review of the design plans is necessary.	<input type="checkbox"/> During rainy seasons	<input type="checkbox"/> Y / <input type="checkbox"/> N	
9	Earthworks operation	- Ensure the contractor performs detailed design and instability checks	<input type="checkbox"/> Before commencement date of construction	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Check if erosion or instabilities were observed.	<input type="checkbox"/> Before commencement date of construction	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- The conditions at the site can be observed by a site inspection along with review of the design plan.	<input type="checkbox"/> Before commencement date of construction	<input type="checkbox"/> Y / <input type="checkbox"/> N	
10	Traffic safety	- Checking the traffic problems at the construction site.	<input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
11	Disturbance to flora	- Inspect ROW boundary and adjacent area	<input type="checkbox"/> Weekly / <input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
12	Disturbance to fauna	- Visit site and check the proposed alignment and construction area	<input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
13	Loss or damage of cultural sites or religious places	- Interviews with local residents will also give a proper assessment of the issue.	<input type="checkbox"/> Once in six months.	<input type="checkbox"/> Y / <input type="checkbox"/> N	
14	Construction labour force and its impacts	- Check if the Contractors are following the mitigation measures	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Check with the communities and construction staff if any conflict has occurred; if yes find out reason.	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- This can be achieved by regular site inspections. The frequency should be once in fifteen days.	<input type="checkbox"/> Weekly	<input type="checkbox"/> Y / <input type="checkbox"/> N	

S.N.	Items	Check Point	Frequency	Evaluation or Mitigation status Y:Good /Yes N: Poor /No	Remark And Signature by Checker
15	Work camp operation	- During construction and after completion of the works. The inspection should be planned once every two months throughout the project period	<input type="checkbox"/> Monthly	<input type="checkbox"/> Y / <input type="checkbox"/> N	
Total				Yes_ No	

**Form 1-3: Monitoring Form during Operation Stage**

Operation Stage:

Monitoring Season:  Pre-monsoon /  Post-monsoon /  Winter

Monitoring Period From     Date    Month    Year      
 To     Date    Month    Year    

S.N.	Items		Frequency	Evaluation or Mitigation status Y: Good / Yes N: Poor / No	Remark And Signature by Checker
1	Noise and vibratin	- Visit site and compare with Normal situation	Periodical	<input type="checkbox"/> Y / <input type="checkbox"/> N	Signature by Inspector
		- Seasonal monitoring	Periodical	As per Form C1-5	
2	Air Quality	- Seasonal monitoring	Periodical	As per Form C1-4	
3	Water Quality	- Seasonal monioring	Periodical	As per Form C1-6, 7	
4	Plantation	- The number of trees surviving during each visit shall be compared with the number of sapling plant	Assess growth every year for initial five years <input type="checkbox"/> 1st/ <input type="checkbox"/> 2nd/ <input type="checkbox"/> 3rd / <input type="checkbox"/> 4th / <input type="checkbox"/> 5th	<input type="checkbox"/> Y / <input type="checkbox"/> N	
		- Record the growth of plantation	Assess growth every year for initial five years <input type="checkbox"/> 1st/ <input type="checkbox"/> 2nd/ <input type="checkbox"/> 3rd / <input type="checkbox"/> 4th / <input type="checkbox"/> 5th	<input type="checkbox"/> Y / <input type="checkbox"/> N	
Total				Yes __, No	

**Monitoring of Impacts and Mitigation Measures**

Environmental and social impact/mitigation monitoring shall be conducted to determine the actual and social impacts. Draft monitoring forms are shown in below.

**Form 1-4: Monitoring of Air Quality**

Type of work:

Monitoring Season:  Pre-monsoon /  Post-monsoon /  Winter

Monitoring Period From     Date    Month    Year    

To     Date    Month    Year    

Item Unit	Date	Item	1	2	3	4	5	6	Remark
			PM <sub>10</sub> µg/m <sup>3</sup>	PM <sub>2.5</sub> µg/m <sup>3</sup>	CO ppm	SO <sub>2</sub> µg/m <sup>3</sup>	NO <sub>x</sub> µg/m <sup>3</sup>	Lead µg/m <sup>3</sup>	
No. 1 (Detail of Location)		Max							
		Ave							
		Min							
No. 2 (Detail of Location)		Max							
		Ave							
		Min							
No. 3 (Detail of Location)		Max							
		Ave							
		Min							
		Max							
		Ave							
		Min							
Baseline Data in EIA Report									
NEQS			100	60	04µg/m <sub>3</sub>	80	80	1	
WHO Standards			150-230	70	30	400	100-150		
Duration			24hs	24hs	24hs	24hs	24hs	24hs	



**Form 1-5: Monitoring of Noise and Vibration**

Type of work:

Monitoring Frequency:  1st /  2nd /  3 rd

Monitoring Period From      Date      Month      Year

To      Date      Month      Year

	Item	Unit	Date1	Date2	Date3	Remark (Date)	
			DD/M M/YY	DD/M M/YY	DD/M M/YY		
NEQS	Noise Residential Area Day Time (6:00-22:00); 55 dB(A) Night Time(22:00-6:00);50dB(A) Silent Area Day Time (6:00-22:00); 45 dB(A) Night Time(22:00-6:00);40dB(A)						
No. 1	(Detail of Location)	Noise-1	L <sub>eq</sub>	dB(A)			
		Noise-2	L <sub>min</sub>	dB(A)			
		Noise-3	L <sub>max</sub>	dB(A)			
		Vib-1	L <sub>10</sub>	dB			
No. 2	(Detail of Location)	Noise-1	L <sub>eq</sub>	dB(A)			
		Noise-2	L <sub>min</sub>	dB(A)			
		Noise-3	L <sub>max</sub>	dB(A)			
		Vib-1	L <sub>10</sub>	dB			
No. 3	(Detail of Location)	Noise-1	L <sub>eq</sub>	dB(A)			
		Noise-2	L <sub>min</sub>	dB(A)			
		Noise-3	L <sub>max</sub>	dB(A)			
		Vib-1	L <sub>10</sub>	dB			
	(Detail of Location)	Noise-1	L <sub>eq</sub>	dB(A)			
		Noise-2	L <sub>min</sub>	dB(A)			
		Noise-3	L <sub>max</sub>	dB(A)			
		Vib-1	L <sub>10</sub>	dB			

**Form 1-6: Monitoring of Surface Water Quality**

Type of work:

Monitoring Times :  1st /  2nd /  3rd

Monitoring Period From      Date      Month      Year

To      Date      Month      Year

No.	Name of River	Location	1	2	3	4	5	6	7	8	9	10	11	12	13
			Temp	pH	E.C	TSS	TDS	Turbidity	T. Hardness	DO	BOD	COD	Nitrate	Ammonia	T.Coli
Unit			°C	-	µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	MPN/100 ml
1		Upstream													
		Down Stream													
2		Upstream													
		Down Stream													
3		Upstream													
		Down Stream													
4		Upstream													
		Down Stream													
5		Upstream													
		Down Stream													
No.	Name of River	Location	14	15	16	17	18	19	20	21	22	23	24	25	
			F.coli	Flow-Velocity	Chloride	Sulphate	Calcium	Magnesium	Fluoride	O&G	Zinc	Manganese	Iron	Copper	
Unit			MPN/100 ml	m/s	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	
1		Upstream													
		Down Stream													
2		Upstream													
		Down Stream													
3		Upstream													
		Down Stream													
4		Upstream													
		Down Stream													
5		Upstream													
		Down Stream													

**Form 1-7: Monitoring of Groundwater / Community Water Tank Quality**

Type of work:

Monitoring Times :  1st /  2nd /  3rd

Monitoring Frequency :  Daily /  Weekly /  Monthly  Seasonal

Monitoring Period From          Date    Month    Year  
   Date    Month    Year  
 To

Monitoring Stage :  Pre-Construction /  Construction /  Post-Construction

Date	Measure Point					
	No.1	No.2	No.3	No.4	No.5	
	(Detail of Location)					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
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21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
31						

**Form 1-8: Monitoring of Land Slide and Soil Erosion**

Detail of location:

Type of work:

Monitoring Times:  1st /  2nd /  3rd

Monitoring Period From     Date    Month    Year  
To     Date    Month    Year

S.N.	Items	Unit	Detail	Remark
1	Current land use			
2	Size of land slide/soil erosion	Km x Km.		
3	Reason of land slide/soil erosion			
4	Past record	DD/MM/YY		
5	Nearest water source (if any)	Nos., kind		

**Form 1-9: Monitoring of Plantation**

Type of work:

Monitoring Times:  1st /  2nd /  3rd

Monitoring Period From     Date    Month    Year  
To     Date    Month    Year

S.N	Location	Village Council	Species	Number of trees	Height of trees (m) Max/Ave/Min	BHD	Growth Excellent/ Good/ Poor	Remark

**Form 1-10: Monitoring of Borrow Area/Surplus Soil Dumping Site**

Location:

Monitoring Times:  1st /  2nd /  3rd

Monitoring Period From     Date    Month    Year  
To     Date    Month    Year

Monitoring Stage :  Pre-Construction /  Construction /  Post-Construction

S.N.	Items	Unit	Detail	Remark
1	Current land use			
2	Size of area	m x m		
3	No. of settlement in the borrow area	Nos.		
4	No. of trees in the borrow area	Nos.		
5	Scale of haul road in the area (if any)	Nos. x Length(km) x Width (m)		
6	Detail of the existing structure (if any)	Nos., kind		
7	Detail of the existing infrastructure (if any)	Nos., kind		
8	Nearest water source (if any)	Nos., kind		

**Form 1-11: Solid Waste**

Location:

Monitoring Times:  1st /  2nd /  3rd

Monitoring Period From     Date    Month    Year  
To     Date    Month    Year

Monitoring Stage :  Pre-Construction /  Construction /  Post-Construction

Monitoring Item	Conditions During the Monitoring Period	Remarks (Designated Area of Disposal/Reuse, CPCB's Rule, Timing and Method of Disposal)
Reused Item:		Based on the "Urban Solid Waste Management Rule 2016", Once a week or any time as disposal was made, etc.
Disposed Item:		ditto



## Appendix-8-2: RAP Monitoring Form

**Table RAP Monitoring Form (RAP performance) for NH54 Bypasses**

Procedure	Indicator (specific step/action)		Unit	Year 1				Year 2				Year 3				Comments
				1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	
Recruitment, training and deployment	1.	Deployment of managerial staff /Consultants	Man-months													
	2.	Deployment of resettlement workers	Man-months													
	3.	Training and mobilization	No. of trained personnel													
Adopting the Resettlement Action Plan	1.	Review of Rehabilitation and Resettlement (R&R) Scheme	%													
	2.	Devise corrections to the R&R Scheme	%													
	3.	Submission of comments to Capital Development Authority	%													
	4.	Approval of R&R Scheme with corrections	%													
Socioeconomic Survey and Census	1.	Designing the Surveys	%													
	2.	Field Survey and collection of data	%													
	3.	Computerization of field data	%													
	4.	Data analysis and report generation														
	5.	Make ready references for future comparison														
Valuation of affected property	1.	Planning for valuation	%													
	2.	Survey & Valuation of Property(Structure) as per Schedule Of Rate (PWD)	%													
	3.	Survey & Valuation of Land as per Mizo Act 2016	%													

Procedure	Indicator (specific step/action)		Unit	Year 1				Year 2				Year 3				Comments
				1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	
	4.	Communication and collection of data	%													
Information campaign	1.	Distribute information brochure	No. distributed													
	2.	Personal contacts	No. contacted													
	3.	Public consultation meetings	Times													
Relocation of Project Affected Persons	1.	Relocation of Eligible Persons (EP)	No. of EPs													
	2.	Payment of Moving Allowance and other transitional support	No. of EPs													
Identification of Eligible Persons	1.	Collection of award data	No. of EPs													
	2.	Assigning ID numbers	No. of EPs													
	3.	Photographing of EPs	No. of EPs													
	4.	Issuance of ID cards	No. of EPs													
	5.	Distribution of ID cards	No. of EPs													
Grievance Redress	1.	Formation of Grievance Redress Committee (GRC)	No. of members													
	2.	Publicizing/notifying of GRC	%													
	3.	Receiving grievance from EP and other stakeholders	No. of cases													
	4.	Resolving grievances	No. of cases													
	5.	Assist EPs in replacement land purchase/Relocation	No. of cases													
	6.	Percentage of cases unresolved	%													
Information Management/ Technical services	1.	Finalization of resettlement budget	%													
	2.	Preparation of information brochure	%													
	3.	Preparation of operation manual	%													
	4.	Preparation of ID card, EP	%													



Procedure	Indicator (specific step/action)	Unit	Year 1				Year 2				Year 3				Comments
			1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	
	file, and Entitlement Cards														
	5. Develop software for Computerized Management Information System (CMIS)	%													
	6. Computerization of award data	No. of EPs													
Payment of Compensation	1. Assist EPs to collect Cash Compensation under Law (Mizo Act 2016)	No. of EPs													
	2. Organize payment of grants from Collector	No. of EPs													
	3. Assist vulnerable EPs in resettlement process and implementation of R&R Scheme	No. of EPs													
Supervision and Management	1. Supply of manpower and logistics	No. of persons													
	2. Liaison with PIU and other agencies	No. of meetings													
	3. Monitoring through Supervision Consultant	Month													
	4. Administrative management	Month													
Performance Reporting	1. Inception report	Date of submission													
	2. Monthly progress report	Date of submission													
	3. Draft final report	Date of submission													
	4. Final report	Date of submission													

**Rehabilitation Monitoring Form**

Major items of action	Specific action steps (sub-items)	Unit	Planned Total	Progress													
				1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5				
1) Training for Rehabilitation	1 Deployment of managerial staff	Man-month															
	2 Deployment of training staff	Man-month															
	3 Training and mobilization	Nos. of Trained personnel															
2) Socioeconomic Survey (after 5 years)	1 Designing the Surveys	%															
	2 Field Survey and collection of data	%															
	3 Computerization of field data	%															
	4 Data analysis and report generation	%															

Grievance Redress Process

Date and Complainants	Contents of Grievance/Complaints	How to deal with/solve grievance/complaints

**RAP Monitoring Form (during RAP implementation) for NH54 Bypasses**

Indicator	Unit (Standard value)	Year 1				Year 2				Year 3				Comments
		1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	
Grievance redress mechanism														
Grievance submitted by the stakeholders	Number of cases													
Grievance resolved	No. of cases (%)													
Conflict with host community	No. of cases													
Other claim/criticism	No. of cases													
Relocation and compensation														
Relocated households	Number (%)													
Compensation completed	No. of cases (%)													
Relocated households owning land	Number (%)													
Relocated households owning domicile	Number (%)													
Relocated households renting land	Number (%)													
Relocated households renting domicile	Number (%)													
Operation of social infrastructure														
Community Water Point	Number (%)													
Pre-schools	Number (%)													
Other Common Public Resource	Number (%)													
Public health and safety (Number per 1,000 people/month) <i>(in case resettlement site is provided for the project)</i>														
Traffic accidents in resettlement site	No. of cases (national average)													
Incidence of diarrhoea	No. of cases (national average)													
Incidence of upper respiratory infection	No. of cases (national average)													
Incidence of tuberculosis	No. of cases (national average)													
Incidence of malaria	No. of cases (national average)													
HIV infection	No. of cases (national average)													
Other epidemics	No. of cases													

Indicator	Unit (Standard value)	Year 1				Year 2				Year 3				Comments
		1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	1st qtr	2nd qtr	3rd qtr	4th qtr	
	(national average)													
Child Diseases	No. of cases (national average)													
Economic														
Project affected household that lacks the source of income	Number (%)													
Project affected household with reduced monthly income	Number (%)													
Employment: Male wage earners	No. of PAPs (%)													
Employment: Female wage earners	No. of PAPs (%)													
Average household income	(Local currency)													
Average household expenditure	(Local currency)													
Income generation: Employment of project affected peoples (PAPs) on construction site														
Employment of project affected peoples (age over 16) by the project	No. of PAPs (%)													
Employment of female PAPs (age over 16) by the project	No. of PAPs (%)													
Child labour	No. of children													
Provision of personal protective equipment (PPE)	PAPs provided with PPE (100%)													
Labour accident	No. of cases													
Livelihood restoration														
Job training conducted	No. of courses													
PAPs (age over 16) that received job training	Number (%)													
Compensated/relocated structure for business (e.g. shop, garage, etc)	Number (%)													
Allocation of substitute farmland (if any)	Area (%)													
Substitute farmland being utilized (if any)	Area (%)													
Income Restoration Process	Number (%)													

Grievance Redress Process

Date and Complainants	Contents of Grievance/Complaints	How to deal with/solve grievance/complaints

### RAP Monitoring Form (post RAP implementation) for NH54 Bypasses

Category <i>(some are relevant only in case resettlement site is provide)</i>	Baseline (6 month period)	Actual/Target					Comments
		Month 6	Month 12	Month 18	Month 24	Month 36	
<b>Social</b>							
Registers crimes/disputes (per 1,000 pop.)							
Crimes/disputes involving women (per 1,000 pop.)							
Crimes/disputes involving vulnerable group (per 1,000 pop.)							
Primary school attendance (male)							
Primary school attendance (female)							
Number of community-based organizations							
<b>Economic</b>							
Average land holding per household (hectares)							
Increase in Per -Capita Incom							
Percentage increase in employment generation							
Percentage households owning land							
Percentage households owning domicile							
Percentage households renting land							
Percentage households renting domicile							
Agricultural production: Maize							
Agricultural production: Rice							
Agricultural production: Others							
Employment: Number of male wage earners							
Employment: Number of female wage earners							
Average household income (Rs. per annum)							
Average household expenditure (Rs. per annum)							
Energy Consumption: Fuelwood (tons per annum)							
Energy Consumption: Kerosene (tons per annum)							
Energy Consumption: Electricity (kWh per annum)							
<b>Health</b>							
Infant mortality rate (per 1000 live birth)							
Increase in average life of the people							
Average weight of children age 5-12 (kg)							
Incidence of diarrhea							

Category <i>(some are relevant only in case resettlement site is provide)</i>	Baseline (6 month period)	Actual/Target					Comments
		Month 6	Month 12	Month 18	Month 24	Month 36	
Incidence of upper respiratory infection							
Incidence of tuberculosis							
Incidence of malaria							
HIV infection							
Other epidemics							
Gender							
Sex-disaggregated data increase (in percentage)							
Women's participation in decision making							
Women trained in various activities							
Change in time spent by women in domestic and farm activities							
Change in women's income, expenditure and savings							
Position of women in different Villages							
Documenting the existing socio-economic profile and labour market conditions of female rural workers							

#### Grievance Redress Process

Date and Complainants	Contents of Grievance/Complaints	How to deal with/solve grievance/complaints

## Appendix-9: Environmental Checklist for NH54 Bypasses

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	N	(a) Preliminary EIA has been prepared as part of Detailed Project Report (DPR) preparation. Since the project does not fall into a category that requires an official EIA, it did not trigger the official EIA process. But in accordance with JICA GL, EIA report has been already prepared.
		(b) Have EIA reports been approved by authorities of the host country's government?	N	(b) As above, the approval is not required under the Indian regulation, but EIA report has been already authorized by Director of NHIDCL.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	(c) N/A
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	N	(d) The project required forest clearance permit for cutting trees and clearing forest for ROW as well as for spoil bank prior to construction activity. The application for permit will be submitted once the ROW (and the exact area of forest to be affected) is finalized. Also, operating stone crusher, hot mix plant during construction stage, the contractor is required to have Consent-for-Establishment and Consent-for-Operation from the Mizoram State Pollution Control Board.
1 Permits and Explanation	(2) Explanation to the Local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	Y	(a) Two rounds of consultation meetings were held in February and July in each BP site. For the second round of consultation, 3 sessions were held in BP2 and BP3 in response to requests from local community to held separate meeting targeting different Village Council. Local people, NGO and government officials from state and district attended these meetings and voiced their expectations/concerns for the project. The invitation was sent out in advance to ensure participation of key stakeholders and the meetings were held in local language (Mizo) to facilitate discussions. The project obtained support from the stakeholders and their feedback has been incorporated into the project design as below.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	Y	(b) One of the major concerns raised during the meetings was treatment of spoil soil which might cause soil erosion if disposed improperly. Appropriate sites for dumping of spoil soil have been identified with measures to prevent soil erosion. Bypasses are designed to avoid impacts to local cemetery (another key concern of community). EMP also include measures to minimize negative impacts on access to water points during construction, another issue raised during the consultation meeting. PAPs prefer cash compensation, and at the same time, requested that the amount to be fair and equivalent to the replacement cost. This requirement is explicitly specified in RAP report.



Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	Y	(a) Alternatives (including zero option) have been studied, particularly to minimize the scale of resettlement in sections that use existing community road. The specification of widening (cutting, filling or both) also takes into account environmental considerations (e.g. minimize spoil soil) as well as technical and economic considerations.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken?	Y	(a) Existing air quality is within the country's air quality standards. The construction activity will lead to temporary increase in vehicular emissions, but mitigation measures including timing of construction activity and watering will be implemented to mitigate negative impacts.
		(b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	N	(b) The project road passes through hilly mountainous area and there is no existing industrial area.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	Y	(a) Soil runoff during construction stage will be minimized by measures such as breast walls, retaining walls, sedimentation chambers, fiber mats, and mulches as necessary. The embankment will be turfed for slope stabilization purposes. Cascading drainage system will be provided for controlling of the erosion from the embankments.
		(b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater?	Y	(b) Negative impacts will be anticipated due to wastewater runoff from construction area and lodging for workers. After completion on the construction of highway, wastewater generated by users and from operation and maintenance activity of highways might deteriorate water quality of river and creek. Measures to prevent/minimize negative impacts will be implemented as proposed in EMP.
		(c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	Y	(c) Effluent during construction work will be adequately managed as per the regulation and as articulated in EMP. The vehicles/equipment will be maintained and re-fuelled in such a fashion that oil/diesel spillage does not occur and contaminate the surrounding soil/water.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	Y	(a) Waste generated from construction workers' camp will be collected and dumped in a designated site as per the regulation. Potential disposal sites for surplus soil have been identified and will be finalized with the final ROW drawing.
	(4) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	Y	(a) Existing noise and vibration levels are within the standard. Construction activity will result in temporary increase in noise and vibration level, but they will be managed as per recommendations in EMP, particularly near sensitive receptors.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	(a) The proposed four bypasses do not traverse or borders with national park, wildlife sanctuary or protected/reserved forest. Since the nearest protected area is more than 10 km away from the proposed bypass route, it is unlikely that the project will affect the protected area, but it is proposed that NHIDCL communicate with State Environment Department to regularly obtain updated information about the condition of the protected areas near the bypass routes.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	(a) The project roads passes through forest area, forest plantation (bamboo etc.) and jhum (shifting cultivation) area, but no endangered or threatened species of flora has been recorded on the area of influence during the field survey.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	Y	(b) No "Endangered" species as per IUCN Red List has been identified during the field survey, but one "Vulnerable" species, Slow Loris, has been found in the project area during the field survey during Phase I survey for the widening of NH54 (Aizawl-Tuipang).
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N	(c) The project will not affect pristine ecosystem and thus ecological impact is not significant.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock?	Y	(d) Measures to prevent impacts on vulnerable and other wildlife will be taken, including distribution of pictures/images of such species to construction workers so that the engineering work can be paused when such species are found nearby.
3 Natural Environment		(e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	Y	(e) The project will result in deforestation as bypasses run through mountain areas. Reforestation will be carried out in line with the requirement of obtaining forest clearance permit.
		(f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	N	(f) While the project passes through hilly mountainous area, human intervention (in the form of jhum and plantation) already took place in the area proposed for bypass. As such, the project is not expected to result in extensive loss of natural environment.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	Y	(a) The constructing activity may cause minor change to local hydrology but the impact is temporally and localized. Drainage is designed based on hydrological analysis to that water runoff does not cause soil erosion or damage road.
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	Y	(a) The project area is prone to slope failure and landslide that often cause disruption to local livelihood. The project identifies such areas and install slope protection and stabilization measures. In BP4, the bypass route has been adjusted to avoid high-risk area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	Y	(b) There is risk that cutting and filling will trigger slope failure or landslide, particularly during the monsoon period. Adequate measures will be included to avoid such hazard, such as sodding and turfing.
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	Y	(c) There is risk of soil runoff, particularly during the monsoon period. Adequate measures will be included to avoid such hazard, including turfing with grasses and shrubs in accordance with the recommended practice IRC guidelines.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	Y	(a) The project will result in a resettlement of 20 households (133 people). The bypass routes are designed to minimize the resettlement, particularly for BP1 and BP2 in which part of the bypass section uses existing community road with some roadside habitation.
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	Y	(b) Affected people have been informed of potential impacts and proposed compensation packages including entitlement through two rounds of consultation meetings.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	Y	(c) Resettlement Action Plan has been prepared based on socio-economic baseline survey targeting all households either living or undertaking economic activities (mostly agriculture) along the proposed bypasses. Reflecting PAPs preference, compensation, including compensation for land, will be made in cash equivalent to replacement cost along with assistance. Based on the RAP report, Mizoram State Government will prepare and implement Rehabilitation and Resettlement Scheme as per Mizoram (Land Acquisition, Rehabilitation and Resettlement) Act, 2016.
		(d) Are the compensations going to be paid prior to the resettlement?	Y	(d) Compensation will be paid before resettlement.
		(e) Are the compensation policies prepared in document, and in case the scale of resettlement is large, has the resettlement plan been disclosed?	Y	(e) A RAP report has been prepared and the contents of the report have been discussed during the consultation meeting. Also, Mizo version of the summary document has been prepared and distributed to all Village Councils in the project area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	Y	(f) Vulnerable groups such as the poor and female-headed household will be entitled to additional assistance, in addition to regular compensation and assistance package.
		(g) Are agreements with the affected people obtained prior to resettlement?	Y	(g) During consultation meetings, stakeholders voiced their support to the project.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	Y	(h) The organizational framework for implementing RAP, including draft TOR for implementing NGO and monitoring form has been developed and included in RAP report. The State government will finalize the budget and NHIDCL will secure the budget based on the request from State Government.
		(i) Are any plans developed to monitor the impacts of resettlement?	Y	(i) RAP includes detailed monitoring and evaluation mechanism.
		(j) Is the grievance redress mechanism established?	Y	(j) Grievance Redress Mechanism will be established prior to relocation of affected people.
	(2) Living and Livelihood	(a) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts?	N	(a) Road transport is the sole mode of transportation in the project area, and as such, no adverse impact is expected to the existing means of transportation and associated workers.
	(b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary?	Y	(b) During construction stage, access to school, church and hospitals and public urinals/water point may be curtailed, potentially affecting local population living near the construction area. Alternate access will be established to avoid significant negative impacts.	

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	Y	(c) In places where contractor(s) workers' camps are established, the health care system including prevention of communicable diseases will be planned. Campaign for raising awareness of these risks will also be held for local community.
		(d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)?	N	(d) Road traffic of the highway is likely to be adversely affected due to construction work temporarily. The timing of construction work is scheduled to minimize such disturbance, and appropriate signs are to be installed to prevent accidents.
		(e) Is there any possibility that roads will impede the movement of inhabitants?	N	(e) Better road will have positive impacts on movement of inhabitants.
		(f) Is there any possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	N	(f) No impact is expected.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	(a) No archaeological sites or cultural/religious heritages are located along the project road.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	(a) Installment of slope protection measures and retaining wall may change aesthetic characteristics of the mountain area, but the impacts are minor and measures will be undertaken to minimize such change, including planting trees on slope.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	Y	(a) Overwhelming majority of the affected people are Scheduled Tribes (Mizo). As such, the RAP takes into account their culture and lifestyle to minimize negative impacts.
		(b) Are all of the rights of ethnic minorities and indigenous people in relation to land and resources respected?	Y	(b) Mizo are not minority in the project area, but all of the rights of ethnic minorities (such as minor sub-group of Mizo) in relation to land and resources will be respected.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	Y	(a) The Project proponent will fulfill the requirements to protect working conditions according to the Labors Act of 1988.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	(b) Safety considerations to prevent injuries and accidents to individuals, such as first-aid kit, Personal Protective Equipment (PPE), secure tamper-proof fence, security lighting, regular security patrols and training, will be undertaken.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	N	(c) Adequate measures will be planned by constructors during the construction as described below. <ul style="list-style-type: none"> <li>✓ Ensure that first aid kits are available in all work areas, supplied with adequate material to treat common workplace injuries;</li> <li>✓ Training of all construction workers in basic sanitation and healthcare issues, general health and safety matters, and on the specific hazards of their work;</li> <li>✓ Dedicated transport should be provided at all work sites to take injured persons to hospitals if needed. Record of all nearest hospitals and health centers should be kept at each construction site;</li> <li>✓ A regular medical facility should be provided at each camp with suitable qualified staff and equipment to treat minor ailments and injuries;</li> </ul>
		(d) Are appropriate measures taken to ensure that security guards involved in the project will not violate safety of other individuals involved, or local residents?	Y	(d) Traffic police for the roadways will be arranged appropriately.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	(a) Adequate measures will be planned and provided to mitigate the negative impacts of environmental pollution during construction stage as described below. <u>Noise and vibration:</u> planning the deliberate and efficient equipment use, use of the low pollution-type machine, regular maintenance of construction machines. <u>Turbid water:</u> Silt fencing to be provided near water bodies. All the construction and preparatory activities including construction of culverts and bridges would be carried out during dry seasons only. <u>Dust, exhaust gases:</u> Regular water sprinkling on unpaved haul roads and vulnerable areas, truck carrying soil, regular maintenance of equipment and trucks <u>Wastes:</u> A designated solid waste disposal site will be secured. In addition, a disposal site should be away from water streams and any archaeological and historical monuments. All areas designated for the storage of fuels, oils, chemicals or other hazardous liquids should have a dense base and be surrounded by a bund to contain any spillage. These areas should be covered by a roof structure to minimize the potential for infiltration and contamination of rainwater.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	Y	(b) Adequate measures will be planned and provided to mitigate the negative impacts to the natural environment during construction stage, such as no construction yard in the forest area.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	Y	(c) Adequate measures will be planned and provided to reduce the negative impacts to the social environment during construction stage, such as provision of traffic signs to minimize congestion and risk of accidents, and provision of alternate access to jhum in the mountain area.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	(a) EMP is proposed for pre-construction, construction and operation stages of the Project. Monitoring shall be done both internally and externally by third party.
		(b) What are the items, methods and frequencies of the monitoring program?	Y	(b) Items, methods and frequencies of the monitoring are listed in EMP in Final EIA/RAP report.
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	(c) Institutional arrangement to carry out EMP is proposed including entities concerned and roles of each entity.



Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	N	(d) There is no regulatory requirement in India such as reporting system of monitoring results. However, the results of monitoring shall be reported to JICA (funding agency) through the project progress reports.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation).	N	(a) As it is mentioned in section 3, the proposed bypass routes do not traverse or border with protected/reserved forest.
		(b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	N	(c) Project does not include such components.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	N	(d) The project is likely to result in greater GHG emissions due to increased traffic level, but the impact is negligible. NHIDCL will discuss this matter with State Government and explore options to mitigate the impacts, particularly through exploring options to reduce traffic jam.

Note:

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Source: JICA Survey Team