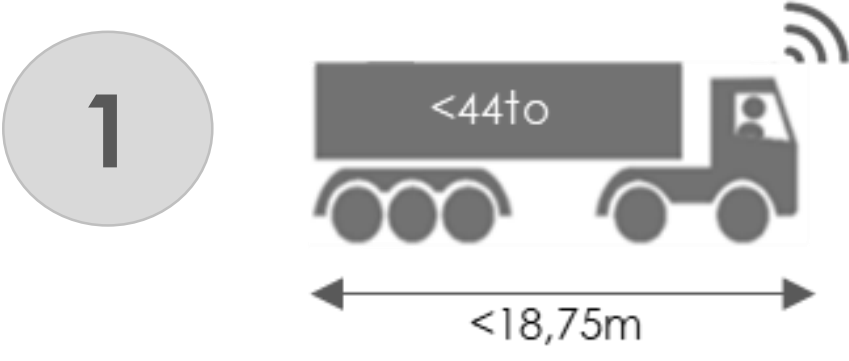
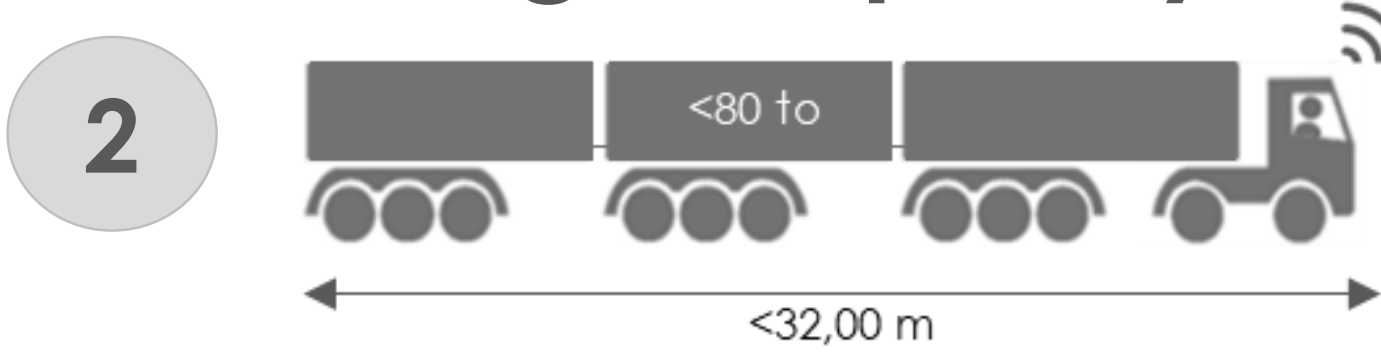



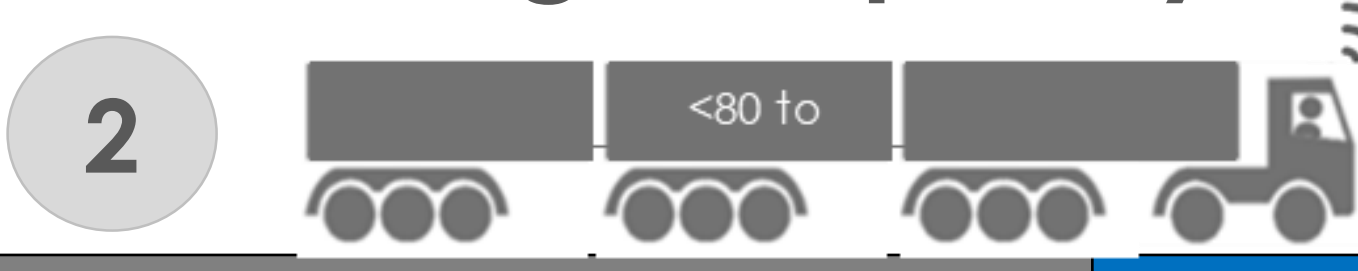
Single automated trucks

Level 4 on motorways

		Common truck+trailer		Future High-capacity vehicle	
					
		Consequences	Necessary Changes	Consequences	Necessary Changes
Pavement	Asphalt pavement	As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. As most vehicles will use same LKA systems wheel paths of vehicles could be rather identical leading to increased fatigue and rutting.	Studies are required to analyze rutting and fatigue potential in case of increasing unification of wheel paths (applies already to current LKA systems). Potential of traffic management measures to be assessed.	If axle loads are not exceeded impact to asphalt pavements should not change. Paulis research shows that more axles increase stress on pavement in particular in case of unified wheel paths. So even in case of same axle loads, changes in deterioration expected	Potentially positive counter effects of defined wheel path offsets need to be further assessed as well as their potential for traffic management measures
	Concrete pavement	As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. Agreed	No changes required	Additional axles could lead to increased stress on joints. If axle loads are not exceeded impact to concrete pavements should not change. Agreed, concrete slabs are considered less sensitive to additional axles	No changes required
	Ramps and junctions	As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. Agreed	No changes required	Ramps and junctions are considered a very difficult area in terms of dimensions, visibility, etc. Each country will need to assess their design parameters of ramps and junctions for 32m long HCVs. Detailed investigation necessary Investigations are necessary	NRAs need to have a clear picture of their ramp designs in order to make traffic management provisions allowing these trucks only where design parameters are ok for them to enter exit.
	Emergency bays / Shoulder	Emergency bays are required in accordance with ODD requirement ideally every 500m or a wide shoulder is present. This is rather an ODD requirement than an impact due to operation of the trucks.	However to avoid congestions and road blocks trucks should be only allowed on routes with necessary space for emergency stops (wide shoulder or emergency bays) so traffic management provisions needs to be prepared.	Emergency bays are required in accordance with ODD requirement ideally every 500m or a wide shoulder is present. This is rather an ODD requirement than an impact due to operation of the trucks.	However to avoid congestions and road blocks trucks should be only allowed on routes with necessary space for emergency stops (wide shoulder or emergency bays) so traffic management provisions needs to be prepared.
	Road marking	Road markings need to be clearly visible in accordance with ODD requirements on the respective slow lanes where trucks are driving. This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required General remark: Road marking can be just an additional guiding system but not the only one an automated truck relies on.	Road markings need to be clearly visible in accordance with ODD requirements on the respective slow lanes where trucks are driving. This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required General remark: Road marking can be just an additional guiding system but not the only one an automated truck relies on.
	General road design	Additional emergency bays in case of no wide shoulder This is rather an ODD requirement than an impact due to operation of the trucks.	Road design standards should be adopted to include emergency bays or wide shoulder for new motorways	New definitions in terms of visibility distance, inclinations, curve definitions expected. Also impacts on road cross sections through increased need for emergency bays. Roundabouts are in particular tricky. However changing all these goes too far, more likely will only certain routes be accessible for such trucks.	NRAs will need to have a clear view of their networks in terms of design parameters. Such trucks might not need to be everywhere but rather on certain routes (eg transit routes, port connections, etc.). Traffic management will apply
	Rest areas/ service stations	Due to less required resting times space might be reduced in the very long run.	No change required	Also problems with size expected, in particular length of parking slots.	Reassessment would be required.

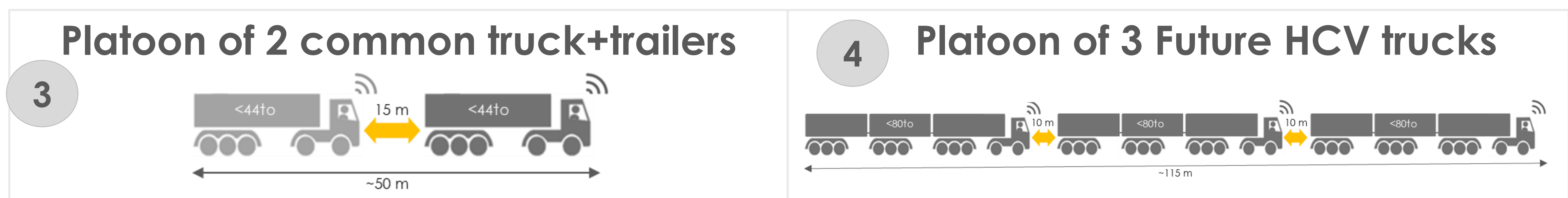
Single automated trucks

Level 4 on motorways

		Common truck+trailer 1 		Future High-capacity vehicle 2 	
		Consequences	Necessary Changes	Consequences	Necessary Changes
Bridges	Bridge structures	As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. Agreed	No changes required	Necessary strengthening of aged or weak bridges might be possible. If axles loads do not exceed current weight restrictions, impact should be limited Agreed	Evaluation of bridges needed based on bridge inspections. Potentially restrictions will be required.
	Joints / Dillatations	As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. As most vehicles will use same LKA systems wheel paths of vehicles could be rather identical leading to punctual loads/ faster deterioration	Monitoring of developement, further research required.	Additional axles increase stress on joints and dilations increasing the risk for road defects before/after dilations. As most vehicles will use same LKA systems wheel paths of vehicles could be rather identical leading to punctual loads/ faster deterioration	Monitoring of developement, further research required.
	Bearings	As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. Agreed	No changes required	Total dynamic load of a moving platoon exceeds existing bridge design scenarios. Aged bridges would potentially need re-calculation and strengthening measures. Agreed	Evaluation of bridges needed based on bridge inspections. Potentially restrictions will be required.
	Rails	None Agreed	No changes required	None Agreed	No changes required
Tunnels	Tunnel structure	None Agreed	No changes required	None Agreed	No changes required
	Tunnel wall finish	Additional guiding functions might be necessary or diffrent requirements for tunnel wall colourings/reflection to allow for the visual sensing of the vehicles to function properly. This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required	Additional guiding functions might be necessary or diffrent requirements for tunnel wall colourings/reflection to allow for the visual sensing of the vehicles to function properly This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required
	Ventilation	None Agreed	No changes required	None Agreed	No changes required
	Lighting	New lighting requirements might be possible to avoid problems with tunnel entries/exits (change of brightness/glare) This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required	New lighting requirements might be possible to avoid problems with tunnel entries/exits (change of brightness/glare) This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required
	Emergency system	Emergency bays are required in accordance with ODD requirement ideally every 500m or a wide shoulder is present. Tunnels under EU directive already have them.	No changes required	Emergency bays are required in accordance with ODD requirement ideally every 500m or a wide shoulder is present. Tunnels under EU directive already have them, length might need to be checked.	Length of emergency bays to be checked for suitability for longer vehicles.
Road furniture & Drainage	Road signs (non-digital)	International/European standardization is deemed critical - machine readable but still human readable. New requirements are expected. A combination of physical and digital "guiding information" will be required This is rather an ODD requirement than an impact due to operation of the trucks.	TN-ITS standards to ensure digital replications. EU wide standardized signs are unrealistic and not necessary.	International/European standardization is deemed critical - machine readable but still human readable. New requirements are expected. A combination of physical and digital "guiding information" will be required. his is rather an ODD requirement than an impact due to operation of the trucks.	TN-ITS standards to ensure digital replications. EU wide standardized signs are unrealistic and not necessary.
	Gantries	None Agreed	No changes required	None Only toll gantries/toll system – covered in toll	No changes required
	Guard rails	None Agreed	No changes required	Strengthening of guard rails in particular in critical areas (bridges, dams) and new standards for heigher loads will be required. Trucks are L4 therefore typical accidents reasons (tire blowouts, tiredness of driver) are eliminated	Requirement for L4 trucks to have fire pressure monitoring systems. Only certain routes. Further assessment needed
	Noise prot. walls	None Agreed	No changes required	None Additional noise might goes beyond current noise wall design parameters.	Noise level evaluation to be adapted
	Road drainage	None Agreed	No changes required	None Agreed	No changes required
	Toll system	None	No changes required	Ability to identify new category to be checked. Impact justifies higher tolls.	New toll category to be incorporated

Truck Platoons

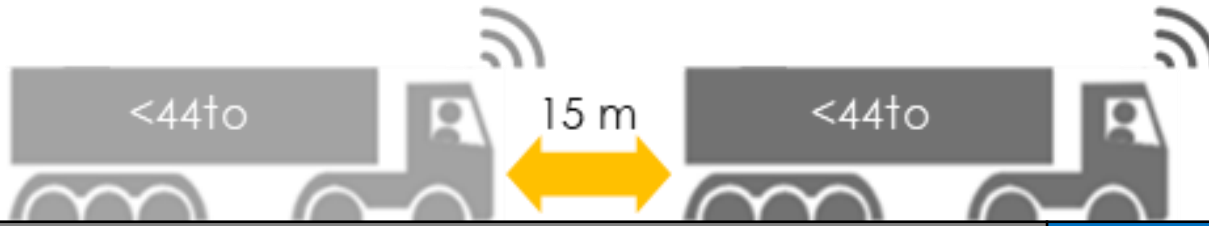
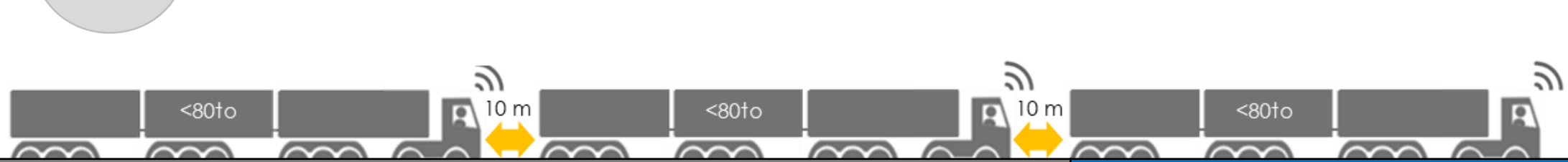
Level 2 and Level 4 on motorways



		Consequences	Necessary Changes	Consequences	Necessary Changes
Pavement	Asphalt pavement	Bigger effects on deterioration (rutting, skid resistance) expected due to shorter pavement relaxation periods between axles. In Northern countries additional impact through spikes possible. Lifecycle models and pavement management system to be potentially adapted. Effects on rutting strongly depend on the lateral track following accuracy of the following vehicles. Agreed	Paulis research shows that more axles increase stress on pavement. Potentially positive counter effects of defined wheel path offsets need to be further assessed as well as their potential for traffic management measures	Bigger effects on deterioration (rutting, skid resistance) expected due to shorter pavement relaxation periods between axles. In Northern countries additional impact through spikes possible. Lifecycle models and pavement management system to be potentially adapted. Effects on rutting strongly depend on the lateral track following accuracy of the following vehicles. Agreed	Paulis research shows that more axles increase stress on pavement. Potentially positive counter effects of defined wheel path offsets need to be further assessed as well as their potential for traffic management measures
	Concrete pavement	Additional axles could lead to increased stress on joints. If axle loads are not exceeded impact to concrete pavements should not change. Agreed, however concrete slabs are considered less sensitive to additional axles	Research on potential of joint strengthening in wheel paths.	Additional axles could lead to increased stress on joints. If axle loads are not exceeded impact to concrete pavements should not change. Agreed, however concrete slabs are considered less sensitive to additional axles	Research on potential of joint strengthening in wheel paths.
	Ramps and junctions	Platoons will need to dissolve when entering ramps and junctions. As dimension and weight restrictions are the same as for conventional trucks, no new impact expected. Agreed	No changes required	Platoons will need to dissolve when entering ramps and junctions. The length of individual vehicles (25.5m) still exceeds the max. length of current trucks. Each country will need to assess their design parameters of ramps and junctions for 25.5m long HCVs. Detailed investigation necessary. Agreed	NRAs need to have a clear picture of their ramp designs in order to make traffic management provisions allowing these trucks only where design parameters are ok for them to enter exit
	Emergency bays / Shoulder	Emergency bays are required in accordance with ODD requirement ideally every 500m or a wide shoulder is present. Emergency bays will need to be at least 200m long. Agreed	Each NRA to assess its current network and decide on potential platooning routes.	Emergency bays are required in accordance with ODD requirement ideally every 500m or a wide shoulder is present. Emergency bays will need to be at least 400m long. Agreed	Each NRA to assess its current network and decide on potential platooning routes.
	Road marking	Road markings need to be clearly visible in accordance with ODD requirements on the respective slow lanes where trucks are driving. This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required General remark: Road marking can be just an additional guiding system but not the only one an automated truck relies on.	Road markings need to be clearly visible in accordance with ODD requirements on the respective slow lanes where trucks are driving. This is rather an ODD requirement than an impact due to operation of the trucks.	No changes required General remark: Road marking can be just an additional guiding system but not the only one an automated truck relies on.
	General road design	New definitions in terms of visibility distance, inclinations, curve definitions expected. Also impacts on road cross sections through increased need for emergency bays. Roundabouts are in particular tricky. However changing all these goes too far, more likely will only certain routes be accessible for platoons.	Design standards to be re-evaluated in particular for specific transit routes where platoons would be beneficial	New definitions in terms of visibility distance, inclinations, curve definitions expected. Also impacts on road cross sections through increased need for emergency bays. HCV platoon will not be able to drive everywhere Limitations to be defined (roundabouts, steepness, etc.)	Only in specific areas feasible. evaluation of road network required. Traffic management to organise routes. Might require separate lane

Truck Platoons

Level 2 and Level 4 on motorways

		 3 Platoon of 2 common truck+trailers		 4 Platoon of 3 Future HCV trucks	
		Consequences	Necessary Changes	Consequences	Necessary Changes
Bridges	Bridge structures	Total dynamic load of a moving platoon exceeds existing bridge design scenarios. Aged bridges would potentially need re-calculation and strengthening measures. Agreed	Evaluation of bridges needed based on bridge inspections. Potentially restrictions will be required.	Total dynamic load of a moving platoon exceeds existing bridge design scenarios. Aged bridges would potentially need re-calculation and strengthening measures. Agreed	Evaluation of bridges needed based on bridge inspections. Potentially restrictions will be required.
	Joints / Dillatations	Additional axles increase stress on joints and dilations increasing the risk for road defects before/after dilations. Agreed	Monitoring of developement, further research required.	Additional axles increase stress on joints and dilations increasing the risk for road defects before/after dilations. Agreed	Monitoring of developement, further research required.
	Bearings	Total dynamic load of a moving platoon might exceed existing bridge design scenarios. Aged bridges would potentially need re-calculation and strengthening measures. Not seen as critical, as loads are not that big with this type of platoon	No changes required	Total dynamic load of a moving platoon exceeds existing bridge design scenarios. Aged bridges would potentially need re-calculation and strengthening measures. Agreed	Evaluation of bridges needed based on bridge inspections. Potentially restrictions will be required.
	Rails	None Agreed	No changes required	None Agreed	No changes required
Tunnels	Tunnel structure	None Agreed	No changes required	None Agreed	No changes required
	Tunnel wall finish	Additional guiding functions might be necessary or diffrent requirements for tunnel wall colourings/reflection to allow for the visual sensing of the vehicles to function properly. ODD requirement, not impact	No changes required	Additional guiding functions might be necessary or diffrent requirements for tunnel wall colourings/reflection to allow for the visual sensing of the vehicles to function properly. ODD requirement, not impact	No changes required
	Ventilation	The condensed number of trucks potentially requires re-assessment of emergency ventilation system. As a result ventilation systems might need an upgrade. Not seen as that critical with a platoon of 2.	No changes required	The condensed number of trucks potentially requires re-assessment of emergency ventilation system. As a result ventilation systems might need an upgrade. Agreed	Studies required to assess aerodynamics and flow
	Lighting	New lighting requirements might be possible to avoid problems with tunnel entries/exits (change of brightness/glare) ODD requirement, not impact	No changes required	New lighting requirements might be possible to avoid problems with tunnel entries/exits (change of brightness/glare) ODD requirement, not impact	No changes required
	Emergency system	Potentially platoons should be requested to dissolve ahead of tunnels. In particular in long tunnels (tunnel directive and above) new emergency routing and systems might be required. Fire protection issues due to possible higher number of trucks driving in platoons. Not seen as that critical with a platoon of 2.	Monitoring system to be checked for suitability	Potentially platoons should be requested to dissolve ahead of tunnels. In particular in long tunnels (tunnel directive and above) new emergency routing and systems might be required. Fire protection issues due to possible higher number of trucks driving in platoons. Agreed	Traffic management to be put in place and monitoring system to set alarm if platoon does not dissolve
Road furniture & Drainage	Road signs (non-digital)	International/European standardization is deemed critical - machine readable but still human readable. New requirements are expected. A combination of physical and digital "guiding information" will be required ODD requirement, not impact	TN-ITS standards to ensure digital replications. EU wide standardized signs are unrealistic and not necessary.	International/European standardization is deemed critical - machine readable but still human readable. New requirements are expected. A combination of physical and digital "guiding information" will be required. ODD requirement, not impact	TN-ITS standards to ensure digital replications. EU wide standardized signs are unrealistic and not necessary.
	Gantries	None Agreed	No changes required	None Agreed	No changes required
	Guard rails	Strengthening of guard rails in particular in critical areas (bridges, dams) and new standards for heigher loads will be required. In particular critical in L2 as driver mistakes still happen.	Careful selection of allowed routes. Either improved guard rails in danger zones or traffic management	Strengthening of guard rails in particular in critical areas (bridges, dams) and new standards for heigher loads will be required. Trucks are L4 therefore typical accident reasons (fire blowouts, tiredness of driver) are eliminated	Requirement for L4 trucks to have fire pressure monitoring systems. Only certain routes. Further assessment needed
	Noise prot. walls	Noise studies to be undertaken, potentially additional noise barrier requirements Agreed	Probably No changes required	Noise studies to be undertaken, potentially additional noise barrier requirements Additional noise might goes beyond current noise wall design parameters.	Noise level evaluation to be adapted
	Road drainage	None Agreed	No changes required	None Agreed	No changes required
	Toll system	Ability to identify new category to be checked. Impact justifies higher tolls.	New toll category to be incorporated	Ability to identify new category to be checked. Impact justifies higher tolls.	New toll category to be incorporated