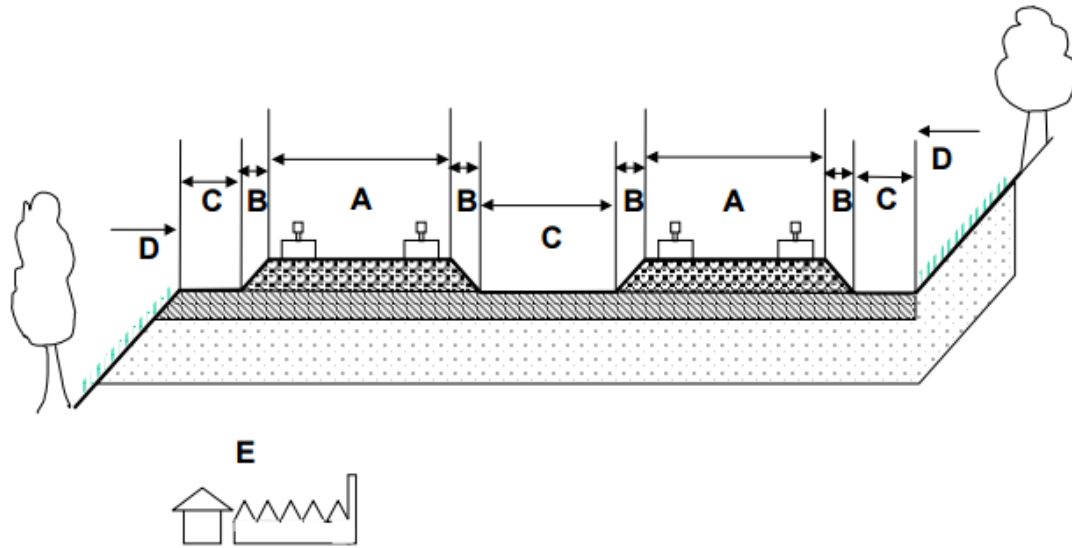


APPENDIX C: RAILROAD DESIGN AND FUNCTION: EXAMPLES OUTREACH MATERIALS



Plants	All plant species not acceptable within defined vegetation control areas in terms of railway company requirements.
Vegetation Control Areas	Selected track areas. Most of the railway companies separate their railway lines into several sections to reflect differing vegetation control measures adopted, frequency of application, the varying durations of application and in some cases shared organizational responsibilities (see areas A to D). The areas belonging to railways away from the track area are also included (see Area E).
Area A	Ballast bed: part of the track-bed made of ballast or gravel including embedded sleepers and rails.
Area B	Ballast shoulder: part of the track-bed covering the slopes on both sides of the ballast bed.
Area C	Transition area: part of the track abutting the slope on both sides of the ballast bed, includes walking path for maintenance reasons/ inspection walk way and areas between two tracks (double and more lines). Drainage ditches are also built in Area C in some cases.
Area D	Embankment: the slopes alongside the track away from the track adjoining Area C
Area E	Outside the track area: all other areas not directly linked with the track such as paths, areas around power supply stations, loading areas, station platforms, parking sites,

Ballast: The function and importance of maintenance

Ballast, also referred to as track ballast or railroad ballast, forms the foundation (i.e., track bed) upon which railway ties are laid.

- Ballast is packed between, below, and around the ties.
- Ballast is necessary to stabilize track, bear the load of the train, facilitate drainage away from the ties and rails, reduce frost heaving and to retard vegetation growth.
- Good quality track ballast is made of crushed stone. The sharp edges help the particles interlock with each other.
- Proper maintenance of railroad ballast is essential for train and public safety.
- Proper maintenance of railroad ballast is expensive and requires regular inspection.
- Poor ballast results in slower train speed.
- Insufficient ballast depth causes overloading of the underlying soil, causing the track to sink, usually unevenly.
- Vegetation management is an important component of ballast maintenance and functions to ensure train/public safety.
- Vegetation management is important for minimizing fire hazards, maintaining visibility, and ensuring proper function of communication lines/signals.
- Poor vegetation management hinders track inspections.
- Vegetation management minimizes the amount of foliage/plant material getting crushed between rails and wheels which can act as a lubricant and affect braking efficacy and operational control.
- Herbicides are typically used to control vegetation in the ballast.
- Many alternative methods of control have been tried without success: steam treatments, fish by-products, use of specific mowing machines, manual weed control-weed whackers, etc. <http://www.mass.gov/eea/docs/agr/pesticides/rightofway/vmp/csx-ma-vmp-2015-2019.pdf>
- Even with management of above ground vegetation, roots left in place may disrupt the proper function of the ballast and hold moisture.
- Maintenance of vegetation should employ an integrated approach, taking into account sensitive areas.
- Maintenance of vegetation should take advantage of mechanical means including alternating mechanical means with chemical means.
- Herbicides with shorter residual times, less movement in soil and water and those that provide the least hazard to human and environmental health should be given priority.
- Lack of effective vegetation management can lead to degradation of ballast, a decline in operational reliability and present significant safety concerns.

- Management of ballast should include regular inspection, regular replenishment of stone ballast and could include a combination of mechanical (mowing/string trimmer) and/or permanent exclusion barrier (cost to be paid by the town) and/or minimal low risk herbicide use on a prescribed schedule to minimize root invasion. This may be an alternating schedule such as Year 1-mow/string trim with no herbicide use Year 2-mow/string trim plus herbicide or other appropriate schedule. Herbicides will be necessary unless a permanent barrier is used since all literature indicates the alternative methods are ineffective, but all efforts will be made to minimize herbicide use over the course of a 1-3 year cycle.

Effects of Plants on a Railway System

Short-term effects (in random order)
<ul style="list-style-type: none"> • Forms rust on fastenings (by creating more shade and hence more humid conditions) • Shortens useful life of wooden sleepers (degradation by in-growing roots increases humidity thus encouraging fungi that attack the wood) • Impedes regular inspection of the track by railway workers and automated inspection systems (by concealing fixing points) • Increases risk of fire (by increasing the amount of flammable plant material under dry conditions) • Reduces workers' safety (work paths made slippery, unevenness due to sub-ground runners, reduced sighting of signals) • Diminishes braking and starting power of trains (bits of plants on rails) • Affects electrical signal systems along the track (by increasing humidity and thus electrical conductivity)
Long-term effects (in random order)
<ul style="list-style-type: none"> • Impairs resistance to frost (by reducing drainage efficiency of ballast bed) • Weakens sub-layers and so enables material to be pumped up to the surface (by impairing drainage) • Increases maintenance tasks involving track stability (by weakening sub-layers) • Shortens cleaning intervals (by increasing amount of fine material along the track)