

## 5 EROSION & SEDIMENT CONTROL

- 5.1 All developments within the City of Campbell River that create land disturbance that could be susceptible to erosion, other than agriculture or forestry that are under jurisdiction of the Province of BC, shall undertake erosion and sediment control (ESC) in accordance with this Part. Erosion controls (source controls) must be the primary control implemented on a construction site. Sediment control shall be implemented only to manage the residual sediment that occurs after effective erosion controls have been applied and sediment controls are not an alternative or replacement for effective erosion controls.

### Performance Standards – Erosion and Sediment Control

- 5.2 Performance standards are intended for large, complex, unusual and innovative developments that create a disturbed area 2000m<sup>2</sup> or greater. Performance Standards set out general guidelines that designs must meet, but allow qualified professionals to determine the methods to meet the guidelines, subject to the written approval of the City. The prescriptive standards described in the following section should be a starting point for the development of any performance standards.
- 5.3 Performance Standards for Erosion and Sediment Control are:
- At the point of discharge from the development site stormwater runoff shall not exceed turbidity levels of 25 Nephelometric Turbidity Units (NTU) during dry conditions and 100 NTU during wet weather conditions. Where spawning areas are situated in the receiving waters, the stormwater runoff shall not, at any time, increase turbidity levels above background levels of the receiving waters.
- 5.4 The proposed system shall be 'equivalent' or better than the Prescriptive Standards.
- 5.5 Required Professional Qualifications for applicants using the Performance Standards approach for Erosion and Sediment Control Design:
- Certified Professional in Erosion and Sediment Control under the certification program administered by the BC Chapter of the Soil and Water Conservation Society and the International Erosion Control Association (IECA).
- 5.6 All developments using the Performance Standards approach shall require an Erosion and Sediment Control Plan (ESCP) that must:
- Focus on protecting the soil surface from erosion (source control) and capture all sediment on-site during each phase of the land development. This includes requirements to control the amount, water quality and velocity of runoff to ensure that no excessive sediment laden water is discharged, either directly or indirectly,

into the Municipal Drainage System or into watercourse features through a combination of best management practices

- Indicate the nature of the project, the potential for environmental impacts, anticipated soil type in all areas to be disturbed and the mitigation measures and monitoring process proposed
- Include phased construction plans, a site location map that distinguishes between primary erosion control techniques and sediment control measures
- Include the location and width of existing or proposed access(es) to the property and wheel wash facilities as required
- Include notes or specifications to provide adequate guidance for the contractor performing the work
- Include layout of the site and lot(s) that promotes use of pervious infiltration areas wherever possible
- Include property lines and other legal designations of the subject property with locations(s) of any existing/proposed lots, buildings, services, or connections to existing services from the site
- Show the location(s) of any existing drainage infrastructure and the proposed measures to protect it
- Include a multi-staged plan which shows the measures for erosion and sediment control during clearing and grubbing , the installation of services, and final works to be completed during the maintenance period
- Include a schedule of the maintenance and final decommissioning of ESC facilities, ponds, and source controls for each of the phases. This will include proposed re-vegetation and stabilization measures for restoring disturbed or exposed soil areas.
- Detail that all ESC facilities and works described in the plan be installed, constructed and operational in accordance with the approved ESC drawings before land disturbance begins. Preliminary inspection and sign off by the designated professional(s) will be required to ensure that ESC facilities and controls have been successfully installed in accordance with the ESC plan drawings
- Include sample and analysis of the water being discharged from the site. Where there is an exceedance of the allowable turbidity (NTU) levels, corrective measures are to be implemented immediately

- Specify environmental monitoring required to inspect at least once a day during construction in the wet season (October 15 – May 15), at least once a day during or within 48 hours after a significant rainfall event (>25mm rainfall per day or 10mm rainfall per hour), and once a week during the dry season (May 16 – October 14) and to carry out alterations if necessary. The qualified professional shall make a written record of their observations available to the City on request.
  - Be certified by the professional(s) who has prepared it
  - Name and provide contact information for the Environmental Monitor appointed to oversee the plan
  - Be reviewed and signed by the Environmental Monitor
  - Every construction site where an ESC Plan has been issued must have a waterproof copy of the ESC Plan, emergency contact information for the site owner, the designated ESC professional(s) and the designated Environmental Monitor for the site in a location visible from outside the construction site, for the duration of the construction project.
- 5.7 The developer and related contractor(s) shall comply with the requirements of the Environmental Monitoring Report(s) within 48 hours of the field review time, or such other time as listed in the Environmental Monitoring Report.

## **Prescriptive Standards – Erosion and Sediment Control**

- 5.8 Intended for small or simple developments that create a disturbed area less than 2000m<sup>2</sup>, Prescriptive Standards set out default best management practices described below that if used with good professional practice are pre-approved by the City.
- 5.9 Required Professional Qualifications for applicants using the Prescriptive Standards approach for Erosion and Sediment Control Design and Supervision:
- Certified Professional in Erosion and Sediment Control under the certification program administered by the BC Chapter of the Soil and Water Conservation Society and the International Erosion Control Association (IECA).

- 5.10 Exemptions: A Certified Professional in Erosion and Sediment Control is not required if the proposed land clearing is shown to the satisfaction of the City in writing to have no negative impact on watercourse habitat (includes streams, ditches and wetlands whether they are wetted or not and whether or not they are considered fish habitat) or the City storm drainage system taking into account the following factors: construction timing and schedule in relation to the Wet Season and the Dry Season; size and location of the proposed land disturbance with respect to the perimeter and sensitivity of the parcel of land on which the works will take place; the soil conditions on the said parcel; existing vegetation and growth; topographical conditions pertinent to drainage.

#### **Required Erosion and Sediment Control Best Management Practices**

- 5.11 Stop land disturbance (construction work) during rain.
- 5.12 A gravel access pad (3.6m wide, 15m long, composed of 50-75mm clean course aggregate, minimum depth of 150mm) for each proposed lot at the point of entry onto the lots from the roadway. They shall be constructed and maintained to minimize the migration of sediment onto the roadways.
- 5.13 Physically mark clearing boundaries on construction sites and ensure temporary fencing is placed around watercourse protection areas and any other designated environmentally sensitive areas or features as determined by a Qualified Environmental Professional.
- 5.14 Install and maintain perimeter ditches, swales, and interceptor ditches on plans that divert runoff away from cleared areas during phased approach and divert runoff into staged primary and auxiliary sediment traps or sediment ponds where appropriate, prior to discharge off site.
- 5.15 Vehicle/machinery access to and from the disturbed area shall be limited to the access pad, staging areas, or prepared working road to minimize soil disturbance.
- 5.16 Wheel wash facilities will be required for all lots during the wet season (October 15 – May 15).
- 5.17 Roadways fronting the disturbed area are to be swept free and cleaned on a regular basis (once a day or more frequently during rain events). Flushing of the roadway is prohibited.
- 5.18 Excavated/imported soils are not to be stockpiled or unloaded on road allowances, curbs, or sidewalks and if soils are stockpiled within the boundary of the lot, then the stockpiles shall be covered with polyethylene sheeting and weighted down. Breaks in the cover must be repaired immediately.
- 5.19 Concrete truck wash and construction wash of exposed aggregate surfaces is not to be directed into any watercourse feature or any storm drain system or catch basin.

- 5.20 All waters captured within foundations, sediment ponds, or when flushing sediment facilities and controls, shall be removed by appropriate sediment and stormwater management controls or by pumper trucks to ensure surface runoff and sediment discharge levels do not exceed NTU guidelines.
- 5.21 Temporary graded areas, such as housing lots, must be protected from erosion through the use of straw, mulch and/or polyethylene tarps in non traffic areas and a gravel cap in zones of construction traffic. Final graded or landscaped areas must have the appropriate permanent surface protection or landscaping in place as soon as possible.
- 5.22 Where slopes exceed three metres in height and are steeper than five percent, or where soil types consist predominantly of clays or fines, immediate surface protection using polyethylene sheeting or tarps must be used during the wet season or when rain events are forecast by Environment Canada within 24 hours. Surface protection should be well anchored to resist wind and prevent major leakage. Breaks in the cover must be repaired immediately.
- 5.23 All bare and exposed areas not under active grading require erosion control measures (tarps, mulches, rolled erosion control products etc) within 1 day in the wet season and within 1 week in the dry season or if rain is forecast within 24 hours or is present, All bare and exposed areas that will be left dormant for longer than 30 days are to be seeded and stabilized with vegetation species prior to October 15 where possible.
- 5.24 Install and maintain drop and / or curb inlet sediment barriers around any catch basins, on all road frontage catch basins and lawn basins collecting runoff from the construction site.
- 5.25 For the purposes of the erosion and sediment control plans and default best management practices:
- 'rain' means when Environment Canada reports rain in the City. Forecasted 'rain' is when this source predicts rainfall within the upcoming 24 hours. Does not include days of 'showers' as defined by Environment Canada.
  - 'wet season' means site works that create soils unprotected by vegetation cover in the period commencing October 15 of any year up to and including May 15 of the next year.
  - 'dry season' means site works that create soils unprotected by vegetation cover in the period commencing May 16 of any year up to and including October 14 of the same year.
  - 'watercourse' means any wetted area including streams, ditches and wetlands whether they are wetted or not and whether or not they are considered fish habitat

**Erosion or Source Controls**

## 5.26 Scheduling and staging

- Identify major construction and land disturbing activities in order to prescribe effective ESC practices prior to start of land disturbance and for all stages of construction
- Clear and grub in stages to maintain vegetation and minimize exposed soil
- Stop active work during rain
- After clearing, hold back grubbing tree roots until grading is to proceed as the root masses and groundcover provide substantial erosion control
- Complete mass grading work, as much as possible in the dry season
- On larger sites divide the project area into small catchment areas, complete grading and erosion control in one area before opening another
- Very large projects must include regular assessments and modifications to reflect changing conditions

## 5.27 Temporary Diversion Ditches and Berms, Drawing CR-ES101

- Limited to small catchments <2ha
- Swale, diversion (interceptor) ditches or berms can be used to help keep work sites dry by intercepting overland flow upslope of the active work area
- Can be used at crest of cut and fill slopes to intercept and prevent runoff over slopes
- Berms must be stabilized immediately after construction
- Because this technique concentrates runoff and increases erosion potential, ensure minimal (1%) ditch grades in erodible material or install erosion control lining or check dams
- Can be used for perimeter control around material stockpiles, note that stockpiles must also be covered or mulched
- Regular inspection and maintenance is required to remove sediment accumulations in created ditches
- Increase the erosion control performance of other BMPs (such as mulches or erosion control blankets) by controlling the amount of runoff flowing over a slope
- Sediment laden water must not be directed to watercourses or the storm drainage system unless runoff meets provincial or federal water quality guidelines

## 5.28 Slope Texturing, Drawing CR-ES102

- Maximum gradient 2H:1V and on slopes >8m in length
- Ensure slope lengths of 30m or less between slope breaks
- Roughens slope soils to minimize erosion and sediment production and encourage infiltration
- Techniques include machine tracking, contour ripping and ploughing
- Provides preferred sites for seed germination and growth
- Not suitable for loose soils or soils prone to compaction
- Post construction considerations, such as mowing, may prohibit the use of certain texturing methods

## 5.29 Mulch Drawing, Drawings CR-ES103 and CR-ES104

- All mulches are difficult to apply on steep slopes
- Organic mulches (compost, wood chips, straw) must be applied at recommended rates to ensure effective temporary control
- Most organic mulches persist for six months to three years
- Seed prior to mulch for long term stabilization
- Depending on mulch type, may be applied by hand or with construction equipment
- If susceptible to water or wind movement, anchor mulch by tracking or tackifier
- Topsoil mulch is limited to slopes 2H:1V or flatter and provides limited erosion control
- Inorganic mulches (gravel or rock blankets) can provide permanent erosion control and can be applied at most times of the year
- Topsoil stripped from a construction site can be reapplied to the site
- If mulch is for short term erosion control it can be used as a stand alone BMP – otherwise mulch must be used in conjunction with other BMPs
- Woodchips may produce deleterious substances detrimental to water quality or prevent /deter vegetation growth
- Inorganic mulches may prevent the establishment of a vegetative cover
- Topsoil mulch may be desirable where existing soil structure, depth, pH, or nutrient balance cannot be amended to provide an adequate growth medium for the desired vegetation

- Topsoil mulch is desirable when native, indigenous grasses and shrubs are desired and seeds or root fragments are “banked” in the soil

#### 5.30 Rolled Erosion Control Products, Drawing CR- ES105

- Not suitable for rocky soils
- Seed prior to application for long term stabilization
- Product manufacturers can provide assistance to assure proper product is selected for slope and soil conditions as well as advising on product lifespan
- Successful installation requires site preparation to ensure intimate contact between product and soil (no roughening)
- Ensure blanket top is trenched in
- Blankets must be overlapped and anchored with staples due to susceptibility to movement by wind and water
- On slopes, concentrated runoff must not be directed over product

#### 5.31 Straw Wattles, Drawing CR-ES106

- Slope application up to 1H:1V
- For use on slopes subject to very low sheetflow velocity and discharge
- For use on slopes susceptible to sheet and rill erosion, dry ravel and freeze/thaw activity
- Not appropriate for erosion or sediment control in concentrated flow (ditches)
- Good for slopes where other sediment retention structures (such as sediment fences) are not feasible
- Product application shall follow the manufactures detailed instructions
- Can be used with live staking as a bioengineering erosion control

#### 5.32 Ditch Check Dams, Drawings CR-ES107, CR-ES108, CR-ES109

- The base elevation of a check dam should be the same level as the top of the check dam below
- For rock dams, rocks must be sized to resist displacement by flowing water; high volume or high velocity flows require design by a qualified professional
- Severe erosion may occur if the dam is undermined or outflanked



- Rock check dams are limited to ditches where the contributing drainage area is <4ha and maximum flow velocity is <1.5m/s and with gradient of 8% or less
- Sand bag and straw bale check dams are limited to drainage ditches where the contributing drainage area is <2ha with a gradient of 5% or less and flow velocities of <0.3m/s
- Straw bale check dams have a short service life of 6 months to one year; must be limited to a height of one bale (300mm) and require extensive maintenance after adverse weather
- Sediment laden runoff must be directed into sediment treatment structures (such as sediment retention ponds) and must not enter into watercourses or the municipal storm drainage system unless it meets provincial or federal water quality guidelines
- Additional sediment control measures will be required to capture and retain fine sediment
- Check dam application can provide effective channel erosion control where a continuous erosion control structure (such as lining the channel with rock) is not practical or desired
- Should not be used as a stand alone erosion control measure

### 5.33 Rock Channel Lining, Drawing CR-ES110

- Effective in ditches subject to higher flow velocities of 2-5m/s, with gradients >2% and with erodible soils
- Rock must meet specification for gradation (size range), durability and angularity; rounded, uniformly sized rocks should be avoided
- Rocks must be clean of fines
- Must incorporate a non-woven geotextile or a gravel blanket underlay to prevent entrainment and displacement of finer materials from the surface of the underlying soil layer
- Sediment laden runoff must be directed into sediment treatment structures (such as sediment retention ponds) and must not enter into watercourses or the municipal storm drainage system unless it meets NTU guidelines.
- Severe erosion may occur if a portion of the blanket is displaced
- Should not be used as a stand alone erosion control measure

## 5.34 Rolled Erosion Control Products in Ditches, Drawing CR-ES111

- Erosion control blankets provide protection in ditches for flow velocities <1m/sec until permanent vegetation is established
- Turf reinforcement mats provide protection in ditches for flow velocities <2m/s until permanent vegetation is established
- Turf reinforcement mats combined with established vegetation are appropriate for flow velocities <3m/s
- Product manufacturers can provide assistance to assure proper product is selected for gradient, discharge and soil conditions as well as detailed installation instructions
- Successful installation requires site preparation to ensure intimate contact between product and soil, not suitable for rocky soil
- Sediment laden runoff must be directed into sediment treatment structures (such as sediment retention ponds) and must not enter into watercourses or the municipal storm drainage system unless it meets NTU guidelines
- Should not be used as a standalone erosion control measure

## 5.35 Temporary Slope Drain, Drawing CR-ES112

- Use where runoff that collects above a cut or fill slope would cause severe erosion if allowed to spill over the slope
- Use in conjunction with diversion berms/ constructed ditches that collect and direct runoff along the top of cut and fill slopes
- Must be sized, installed and maintained properly to ensure function until permanent slope drain is installed, slopes are stabilized with vegetation or diversion ditch/berm constructed upslope has been removed
- Inlet and drain outlets must be properly constructed to prevent severe erosion
- Runoff after flowing through drain must be directed to a non-erodible area or into non-erodible structures designed to convey runoff through a construction site
- Sediment laden runoff must be directed into sediment treatment structures (such as sediment retention ponds) and must not enter into watercourses or the municipal storm drainage system unless it meets NTU guidelines
- Requires secure anchoring to slope
- Must not be used as a standalone erosion control measure

### 5.36 Energy Dissipater, Drawing CR-ES113

- Use at outlets of slope drains, culverts, conduits or channels with significant flow, commonly either precast concrete or riprap/geotextile
- Use where the discharge velocity from the water conveyance structure exceeds the permissible velocity of the receiving watercourse or disposal area
- Dissipaters should reduce runoff velocities to < 2m/s
- Rock must meet specification for gradation (size range), durability and angularity (rounded and uniformly sized rocks should be avoided)
- Rock must be clean of fines
- Sediment laden runoff must be directed into sediment treatment structures (such as sediment retention ponds) and must not enter into watercourses or the municipal storm drainage system unless it meets NTU guidelines
- Severe erosion may occur if a portion of the dissipater is displaced or if runoff has sufficient velocity after flowing over the dissipater
- Must not be used as a stand alone erosion control measure

### 5.37 Seeding

- Seed promptly after construction, no soil should be left unseeded for >30 days
- Grade to final contour, install other erosion and sediment controls, decompact subsoils 75 to 150mm depth, apply minimum of 50mm topsoil
- Consult specialist or seed distributor to determine appropriate seed mixture, application rates, seasonal planting windows; soil amendments may be required
- Seeding will be most effective if completed during seasonal planting windows
- Temporary erosion and sediment control measures must be applied and maintained until the vegetation cover is established
- Areas where seeding has not resulted in a stabilizing vegetative cover will require reseeded
- Seeded areas may require irrigation to ensure successful establishment of a vegetation cover prior to seasonal heavy rains
- Seed mixtures must compliment long term vegetation goals for site

### 5.38 Hydroseeding – Hydromulching

- Can be used to apply a number of complementary erosion control and soil amendment materials in one or more application

- Useful when seedbed preparation is impractical or an unacceptable level of soil disturbance would result from seedbed preparation
- Soil surface can be left irregular and applications can be used on steep or inaccessible slope where other seeding and mulching methods may be impractical or unsafe

#### 5.39 Polyethylene Sheeting, Drawing CR-ES114

- Must be installed by hand to prevent tearing
- Used for short periods of inactivity or immediate erosion control of erodible surfaces during rain events
- Requires frequent inspection and maintenance to remain effective and not recommended as a long-term measure >45 days
- Continuous perimeter anchoring is critical for successful implementation
- Minimum sheet thickness should be 6 mil (6/1000 of an inch)
- Sediment laden runoff must be directed into sediment treatment structures (such as sediment retention ponds) and must not enter into watercourses or the municipal storm drainage system unless it meets NTU guidelines

### **Sediment Controls**

#### 5.40 Sediment Fencing, Drawings CR-ES115, CR-ES116 and CR-ES117

- Sediment fencing must be properly installed as per manufacturers' directions – improper installation is the major reason for ineffectiveness and failure of this BMP
- Drainage area should not exceed 0.1 ha per 30m of sediment fence
- Runoff flow path length upslope of sediment fence should be <30m
- Maximum slope gradient upslope of sediment fence should be 2H:1V
- Install on contour on nearly flat ground offset at least 2m from toe of slope
- Install in “J” or smile on contour to maximize ponding efficiency
- Maximum length of a single fence should be <40m
- Fences should be no higher than 0.6m
- Maximum sediment build-up should be less than ½ the height of the sediment fence or 0.2m

- Retained sediment must be removed when sediment contained exceeds 225mm in height and the sediment fence must be inspected and maintained on a regular basis
- Added support in the form of additional posts may be required to support large volumes of water that may be retained behind a sediment fence
- Useable life is one year if installed, inspected and maintained properly
- Should not be used as a control measure for fine textured soils
- Do not install in or across defined drainage, ditch or watercourse for flow or sediment control
- May be effective for sand and coarse silt

#### 5.41 Sediment Retention Berm, Continuous Berm, Earth Dykes, Drawing CR-ES118

- Berm may have to be wrapped in geotextile
- Retained sediment must be removed and the berm must be inspected and maintained on a regular basis; maximum sediment build-up should be 1/3 the height of the berm
- Footprint of berm must be seeded after berm is removed
- Do not install in or across defined drainage, ditch or watercourse for flow or sediment control
- Not for use at locations where high discharge is likely to occur

#### 5.42 Stabilized Worksite Entrance, Drawing CR-ES119

- All construction site entrances/exits that adjoin public roads must have a stabilized temporary gravel pad
- Constructed from 50-75 mm clean course aggregate to a minimum depth of 150mm
- Place geotextile fabric under pad to improve pad stability
- Pad should be the full width of the entrance/exit point and should not be less than 3.6m wide with a minimum length of 15m
- Avoid entrances with steep grades and entrances that enter public roads at a curve
- Aggregate must be maintained to ensure sediment and runoff is retained on site
- Sediment tracked onto public roads must be removed immediately

- Vehicle undercarriages and wheels must be washed to minimize amount of sediment being transported from site
- Additional measures to collect sediment from the gravel pads, such as sediment retention pond, are required

#### 5.43 Drop and Curb Inlet Sediment Barriers, Drawings CR-ES120 and CR-ES121

- Drop inlet sediment barrier use is limited to: relatively flat areas (slope <5%) where runoff velocity and volume areas are low; contributing drainage <0.4ha; areas with sheetflow drainage and concentrated flows <0.014m<sup>3</sup>/s
- Drop inlets should have approximately 25m<sup>3</sup> of sediment storage available per disturbed 0.4ha
- Curb Inlet sediment barriers are limited to gentle sloping paved streets where water can pond and discharge is very low at <0.01m<sup>3</sup>/s and sediment must be removed after each rain event
- Made from gravel filled sandbags or supported structures of filter cloth and drain rock
- Must be used in combination with other erosion and sediment control measures.
- Not suitable for locations where high discharge is likely to occur
- May not be suitable measure if water will pool on traveled roadway or extend beyond the construction site

#### 5.44 Sediment Retention Pond Drawings CR-ES122 and CR-ES123

- Requires design by qualified personnel to provide adequate size for water and sediment storage (about 140 m<sup>3</sup>/ha)
- Locate at the stormwater outlet from the site but not in riparian areas or other environmentally sensitive areas as identified in Chapter 9 of the City of Campbell River Official Community Plan
- Design or use baffles to create a minimum of 3:1 length:width ratio (9:1 preferred) to allow sediment to settle
- During development, stormwater shall be routed through sediment basin/ponds as per Drawings CR-ES122 and CR-ES123 prior to entering the stormwater drainage system
- Ponds shall be designed to accommodate a minimum retention time of 40 minutes with a minimum drawdown time of 48 hours

- A primary spillway shall be designed to accommodate the post-development run-off generated by a 1:10 year storm event
- An emergency spillway shall be designed to accommodate the post-development run-off generated by a 1:100 year storm event
- The minimum sediment storage depth shall be 0.5m while the minimum live storage shall be 0.5m above the maximum designed sediment level
- A minimum freeboard of 0.6m shall be provided above the designed maximum live storage level
- The effective length to width ratio of the sediment control trap should be at least 5:1
- The pond walls shall be constructed with a minimum interior side slope of 2H:1V and a minimum exterior side slope of 3H:1V
- The top of the pond bank should be a minimum width of 3.0m
- A pretreatment sump is to be provided at the inlet to the pond
- Where required, the design of the outfall structure shall be determined based on the exit velocity of the stormwater runoff from the pond
- If sediment retention ponds will not provide the required NTU guideline levels or where lack of space does not permit adequate detention times, mechanical filtering devices or chemical agents (i.e. flocculants) may be required. Prior approval for flocculent use must be secured from regulatory agencies
- Accumulated sediment should be removed from each facility when it is determined that the facility is no longer effectively removing sediment and this work is to be performed only during dry periods
- Ponds shall be constructed during initial site development and shall be maintained by the developer until directed by the City, at which time the pond(s) are to be removed or retrofitted for use as stormwater detention ponds