growth leads to high biomass, sometimes termed "bloom" events, STXs can reach concentrations in raw water that are potentially hazardous to human health. Such blooms tend to recur in the same water bodies. Cells of some cyanobacterial species (e.g. *Raphidiopsis*, *Aphanizomenon*, *Dolichospermum*) may accumulate at the surface as scums. Such accumulations may develop rapidly and may be of very variable duration (hours to weeks). In many circumstances, blooms and accumulations are seasonal, whereas others occur perennially.

Cyanobacteria are most effectively controlled in the context of developing a WSP (see chapter 4). Control measures to manage potential risks from cyanobacteria, and in particular from their toxins, in drinking-water should include not only adequate treatment, but also measures to control cyanobacterial bloom development. See section 11.5 for more information on cyanobacteria, including further details on monitoring cyanobacterial blooms, the alert level framework, and prevention and management of cyanobacteria in source waters. Effectively minimizing the formation of blooms and locating the raw water intake away from blooms reduce the treatment steps required to remove cyanotoxins.

Drinking-water treatment that removes particles—that is, soil, slow sand or riverbank filtration, conventional water treatment (coagulation, flocculation and filtration) or dissolved air flotation—can remove cell-bound STXs effectively. Soil, slow sand and riverbank filtration can also remove dissolved cyanotoxins. For all these processes, it important that they are optimized to target the removal of cells and dissolved toxins. Chlorination and ozonation at sufficiently high doses and contact times are effective for degrading dissolved STXs; however, elevated organic carbon in bloom situations will substantially increase the disinfectant demand. Chlorine dioxide and chloramine are ineffective for degrading STXs. Both for pre-oxidaton and conventional treatment, cell rupture and toxin release should be avoided. GAC and PAC can be effective for removing dissolved STXs, with efficacy dependent on several factors, including the type of activated carbon, contact times (PAC), flow rates (GAC) and water quality. As the challenges that blooms present for treatment are complex, periodic validation of efficacy during bloom situations and under the specific local conditions is particularly important. Avoiding bloom occurrence and intake is therefore the preferred option.

Selenium

Selenium is present in Earth's crust, often in association with sulfur-containing minerals. Selenium is an essential trace element, and foodstuffs such as cereals, meat and fish are the principal source of selenium for the general population. Levels in food also vary greatly according to geographical area of production. However, even in high-selenium areas, the relative contribution of selenium from drinking-water is likely to be small in comparison with that from locally produced food.

Provisional guideline value	0.04 mg/l (40 μg/l)
	The guideline value is designated as provisional because of the uncertainties inherent in the scientific database.

Occurrence	Most drinking-water contains concentrations of selenium that are much lower than 10 μg/l, except in certain seleniferous areas
Basis of guideline value derivation	An allocation of 20% of the upper tolerable intake of 400 μg/day to drinking-water provides a sensible balance that will assist regulators and suppliers in making decisions about whether further action is needed
Limit of detection	0.5 μg/l by hydride generation AAS
Treatment performance	Selenium is not removed by conventional treatment processes; significant removals of selenium from water using activated alumina adsorption, ion exchange, reverse osmosis and nanofiltration have been reported.
Guideline value derivation	
• allocation to water	20% of upper tolerable intake
• consumption	2 litres/day
Additional comments	It is important that a proper balance be achieved between recommended intakes and undesirable intakes in determining an appropriate guideline value for selenium in drinking-water. While for most parts of the world, the concentration of selenium in drinking-water will not exceed 10 μg/l, there are circumstances in which selenium may be elevated significantly above normal concentrations, and guidance may be required. Where selenium intake from the diet is known, this should be used in determining a concentration that ensures that intake is safe and sufficient. Where selenium intake from the diet is not known, guidance may be required.
	For most Member States, a drinking-water guideline for selenium is unnecessary. Where there are regions of high intake from a number of sources, of which drinking-water may be one, then Member States should take into consideration exposure from all sources in determining actions to reduce exposure. For drinking-water, this may include using alternative sources, blending low-selenium sources with high-selenium sources as well as considering selenium removal.
Assessment date	2010
Principal references	FAO/WHO (2004) *Vitamin and mineral requirements in human nutrition* WHO (2011) *Selenium in drinking-water*

Selenium is an essential element for humans, and there are indications that selenium status may be marginal in many parts of the world, including western Europe. The potential for adverse effects from selenium deficiency appears to be dependent on a number of factors, including overall health and nutritional status. Very low selenium status in humans has been associated with a juvenile, multifocal myocarditis called Keshan disease and a chondrodystrophy called Kaschin-Beck disease. Several studies have also found blood selenium levels to be inversely associated with the prevalence of several types of cancer.

High intakes of selenium are also associated with a number of specific diseases and the potential for adverse effects, but, again, this seems to be strongly influenced by other factors. Symptoms in people with high urinary selenium levels included gastrointestinal disturbances, discoloration of the skin, decayed teeth, hair or nail loss, nail abnormalities and changes in peripheral nerves. Slight biochemical changes have also been observed. One case of selenium toxicity directly attributable to a water source (well water containing selenium at a concentration of 9 mg/l) has been reported. The average dietary intake that is associated with selenosis has been found to be in excess of 900 µg/day.

As selenium is an essential element, various national and international organizations have established recommended daily intakes of selenium. A joint FAO/WHO consultation recommended intakes of 6–21 µg of selenium per day for infants and children, according to age, 26 and 30 µg of selenium per day for adolescent females and males, respectively, and 26 and 35 µg of selenium per day for adult females and males, respectively.

Because of concern about the adverse effects resulting from exposure to excessive levels of selenium, various national and international organizations have established upper limits of exposure for selenium. FAO/WHO established an upper tolerable limit for selenium of 400 µg/day.

Silver

Silver occurs naturally, mainly in the form of its very insoluble and immobile sulfide, oxides and some salts. Silver ions are primarily found in the +1 oxidation state, and the ionic compounds silver nitrate (soluble) and silver chloride (relatively insoluble) are the most important forms of silver for drinking-water. Silver can also occur as nanoparticles, which can be present in water bodies as a result of release into the environment from wastewater or industrial discharges. When silver is used in point-of-use water treatment devices, drinking-water is expected to be the major source of exposure to silver.

Reason for not establishing a guideline value	Available data inadequate to permit derivation of health-based guideline value, and silver usually occurs in drinking-water at concentrations well below those of health concern
Provisional reference value*	0.1 mg/l
Occurrence	In surface water and groundwater, silver concentrations are usually below 5 µg/l; however, detections >100 µg/l, although rare, have been reported
TDI	A formal TDI could not be derived because of database limitations. However, 0.6 mg/kg bw of colloidal silver per day was considered a LOAEL based on a case report of argyria in a woman who ingested this dose of silver for 16 months. An uncertainty factor of 100 (10 for intraspecies variability and 10 for database limitations) was applied. The database limitations include the short duration of the study, uncertainty associated with a dose level derived from human recall and use of a LOAEL instead of a NOAEL.
Limit of detection	2 ng/ by neutron activation analysis; 5 ng/l by ICP-MS; 2 µg/l by graphite furnace AAS; 10 µg/l by a spectrographic and colorimetric method with dithizone for a 20 ml sample. In addition, asymmetric flow field-flow fractionation in combination with single particle ICP-MS can differentiate between silver nanoparticles and dissolved silver, although this method has not yet been standardized. Since ionic silver can be released from silver nanoparticles, it may be difficult to determine whether silver dispersed in water has originated from the ionic or the particulate fraction.