Table 2 Seven main ways that non-native species can affect the quantity and regulation of water, mechanisms by which they do so and likely impacts on the hydrological cycle. Changes in water quantity mostly affect supporting and provisioning services, whereas changes in water regulation mostly affect provisioning and regulating services. Cultural services can be affected by any change depending on the human values of a given system. Characteristics of non-native species that may be linked with species' impacts on hydrology are noted (some hypothesized, some observed), along with some iconic examples where they exist. Water regulation refers to the distribution and flows of water in space and time. Refer to ISSG (2015) for authorities of species names. Table compiled using information from: (Holdsworth and Mark 1990; Calder and Dye 2001; MA 2005; Charles and Dukes 2007; van Wilgen, Reyers et al. 2008; Deo, Syktus et al. 2009; Pejchar and Mooney 2009; Ehrenfeld 2010; Vilà, Basnou et al. 2010; ISSG 2015 and references therein).

Invader effects	Mechanisms of impact	Impacts on hydrological cycle	Species characteristics	Examples
Water quantity				
1) Local and regional climate	Non-native plants change surface roughness, temperature and albedo, and land-air transfers of heat and moisture	Indirect, cumulative changes to precipitation and evaporation in catchment	Different structural form to native vegetation; high transpiration rates; darker foliage	Invasion of grasslands and heathlands by non-native trees
2) Water use	Non-native plant populations increase interception and evaporation because of differences in their morphology, structure and population densities	Increased evapotranspiration and water storage in plants; greater portion of water intercepted by vegetation aboveground and immediately evaporated; lower	Novel life forms change vegetation structure; low intraspecific competition allows species to reach high densities	Pasture grasses; giant reed *Arundo donax*; non-native trees

	differs from natives because of their life stage (young plants use more water), growth rates or photosynthetic pathway (C3 plants use more water than C4 and CAM plants)	runoff, especially during plant growth season	population growth; age distribution of population (e.g. dominance of juveniles); photosynthetic pathways	*globulus*
	Non-native plants have greater access to soil moisture and groundwater	Lowers water table; reduces aquifer recharge, groundwater storage and base flows	Deep roots; expansive root system; high root biomass; novel life form (e.g. tree in heathlands)	Tamarisk; mesquite *Prosopis* species; mimosa; pines; wattles *Acacia* species
	Non-native animals and pathogens reduce biomass and productivity of native vegetation	Lower water use, interception and evapotranspiration increase water availability and decrease water residence time; higher flood risk	Herbivores that reduce vegetation productivity	Rabbits and other terrestrial herbivores
Water regulation				
3) Seasonality of water use	Timing of growth of non-native plants differs from native plants	Seasonal changes in water availability	Different growth season to native (e.g. C3 vs C4 and CAM plants, deciduous vs evergreen)	Willows and poplars in Australia; yellow star thistle *Centaurea solstitialis* in US
4) Ground surface and soil texture modification	Non-native species change physical structure of ground and infiltration capacity of soil	Changes to runoff flow paths and velocities; changes in surface water ponding and infiltration location and rates; change in water residence time, storage and flows	Plants: distinct from natives in type and amount of biomass, chemical composition and amount of litter, dead wood, root structure, root biomass, timing of leaf senescence.	Plants that different in structure or biomass from native vegetation Animals: common earthworm *Lumbricus*

			Animals: behavior related to burrowing, digging; soil dwelling invertebrates.	*terrestris* and other earthworms; rabbits
5) Wetland encroachment, channel narrowing and sedimentation	Non-native plants trap sediment and encroach channels, wetlands and floodplains	Reduced flood attenuation and water residence times; altered hydraulics, flow paths and velocities; flashier hydrographs; faster runoff; increased flood risk; impedes navigation	Plant structure and morphology that reduces flow speeds and traps sediment; plastic growth form; capacity for clonal spread	Tamarisk; mimosa; giant reed *Arundo donax*; sagittaria; common reed *Phragmites australis*
6) Destruction and erosion of channel form	Growth form of plants and behavior of animals can cause channel collapse, sediment erosion and change flow paths	Altered channel morphology, sediment size and hydraulics changes patterns and velocities of water flow	Plants: different root structure and morphology from natives. Animals: burrowing, dam building, benthic feeders.	Plants: willows and poplars Animals: pigs; carp; beavers; coypu *Myocastor coypus;* Chinese mitten crab *Eriocheir sinensis*
7) Channel water flow	Non-native species clog waterways and infrastructure	Slowing and impeding water flow; water pondage; impedes navigation and hydropower production	Plants: floating or submerged plants that can form dense stands (often monocultures); clonal; rapid population growth Animals: habitat-forming	Plants: salvinia; water hyacinth; Eurasian water-milfoil Animals: Bivalves
	Non-native bivalves armour channel	Reduction in channel roughness increases flow velocity, reduces storage times, increases flood risk	Bivalves with hard surfaces	Freshwater mussels, e.g. zebra mussel and quagga mussel from

		downstream		*Dreissena* genus
	Grazing by non-native animals reduces abundance of aquatic macrophytes	Reduced channel roughness; increased erosion, sediment suspension and transport; increased flow velocities; flashier hydrographs; increased flood risk downstream	Voracious herbivores	Carp; coypu *Myocastor coypus;* golden apple snail *Pomacea canaliculata;* rusty crayfish *Orconectes rusticus*