Table A-19.C. Technical implementation considerations for phytotechnologies

Data requirements	Site-specific data for technology evaluation	Soil conditions	Soil structure, compaction and fertility determine the ability to support plants and develop fertilization and soil amendment plans. Compaction determines rooting penetration and patterns.
		Hydrology/geology	Soil structure determines erosion and infiltration potentials.
		Plant biology	Nutrient content, pH, salinity/conductivity, moisture capacity and retention, and organic matter content determine sustainable growth.
		Climate conditions	Precipitation patterns, relative humidity and pan evaporation rates for water management. Temperature ranges, frost dates, precipitation patterns.
		Safety precautions	Medium to heavy equipment may be used for planting.
		Available power/utilities	On occasion, the system may need power for monitoring or irrigation equipment.
	Pilot-scale testing	Not usually needed for light- to middle-distillate petroleum products. If testing is desired, phased implementation and use of test plots may be employed.	
	Full-scale design	Models	Models may be needed for generally describing hydraulics (i.e. water flow and water balance) and remediation (i.e. rate of degradation or attenuation).
		Water balance	For phytostabilization, systems are designed to prevent infiltration and usually entail a water balance model that considers hydraulic load in the contaminated soil. For hydraulic control systems to maintain containment, a site-wide water balance will be needed.
		Infrastructure and Site Preparation	Phytotechnology systems have similar infrastructure and site preparation requirements to what most remediation systems require, such as earthwork, clearing and grubbing, storm water management, accessibility, fencing/security, etc. There may be a need for basic utilities to run pumps, controllers, automated sprinkler systems, monitoring equipment, etc.
		Irrigation systems, infiltration control and storm water management.	Irrigation systems may need to be installed or modified to ensure vigorous plant growth. Soil mounding, contouring/grading, and impermeable or semipermeable barriers may be needed to restrict or control total infiltration.
		Fencing and security	Phytotechnology systems are ever changing and growing. Thus special design considerations should be given to accommodate how the system will change the appearance and accessibility throughout the site over time. Entry into the site may need to be restricted.
		Soil preparation	All systems will require some form of soil preparation. Similar to agriculture, tilling, fertilizing, planting and irrigation should be done according to application guidelines and rules.
		Plant selection, plant stock and planting methods	The final selection of plants during the design phase includes consideration of commercial availability and plantability.
	Performance and optimization metrics	For proper effectiveness, operation and monitoring should maintain and monitor vigorous plant growth by providing an optimum growth environment. This includes reducing competition and predation and performing seasonal activities that prepare the plants for the next season. Pest control and replanting may also be needed.	
		Standard soil and water analytical results as the primary line of evidence. Monitor changes in groundwater levels across the planted area.	
Further information		Van Epps, A. 2006. Phytoremediation of Petroleum Hydrocarbons. https://clu-in.org/download/studentpapers/A_Van_Epps-Final.pdf	

	ITRC, 2009. Phytotechnology Technical and Regulatory Guidance and Decision Trees, Revised. https://www.itrcweb.org/Guidance/GetDocument?documentID=64&documentID=64
	USEPA 2000. Introduction to Phytoremediation. EPA/600/R-99/107. https://clu-in.org/download/remed/introphyto.pdf
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