Engineered injection and extraction (EIE) is a proposed in-situ contaminant remediation strategy that induces spatially and temporally varied flow fields to accelerate scalar mixing and reaction in the subsurface. Laboratory experiments were performed to quantify the effect of EIE on mixing in monodisperse porous media, and then compared with corresponding numerical simulations. Laser-induced fluorescence was used to quantify the evolution and distribution of scalar concentration fields in a quasi-two-dimensional flow apparatus containing 3 mm Pyrex glass beads that were refractive index matched to the pore fluid, glycerin. The apparatus had a 50 cm x 50 cm spatial extent, with measurements averaged through a 4 cm depth (13 bead layers), allowing for sub-millimeter-scale image resolution of plume structure. Novel methods include a system for loading spherical beads to achieve nearly homogenous hexagonal close packing, a depth-averaged porosity mapping technique, a method for mitigating wall effects, and a technique for imaging multi-species scalar mixing in porous media. Data were collected from experiments designed to test the efficacy of three EIE configurations. Experimental results were compared with those attained from numerical models, showing good qualitative agreement. Duplicate experimental data were highly reproducible. Data from the experiments could be used to improve our understanding of dispersive phenomena in porous media and improve numerical models. Experimental methods could be extended to a range of research interests.