Abstract. We define for each $g \geqslant 2$ and $k \geqslant 0$ a set $\mathcal{M}_{g,k}$ of orientable hyperbolic 3-manifolds with k toric cusps and a connected totally geodesic boundary of genus g. Manifolds in $\mathcal{M}_{g,k}$ have Matveev complexity $g+k$ and Heegaard genus $g+1$, and their homology, volume, and Turaev-Viro invariants depend only on g and k. In addition, they do not contain closed essential surfaces. The cardinality of $\mathcal{M}_{g,k}$ for a fixed k has growth type g^g.

We completely describe the non-hyperbolic Dehn fillings of each M in $\mathcal{M}_{g,k}$, showing that, on any cusp of any hyperbolic manifold obtained by partially filling M, there are precisely 6 non-hyperbolic Dehn fillings: three contain essential discs, and the other three contain essential annuli. This gives an infinite class of large hyperbolic manifolds (in the sense of Wu) with ∂-reducible and annular Dehn fillings having distance 2, and allows us to prove that the corresponding upper bound found by Wu is sharp. If M has one cusp only, the three ∂-reducible fillings are handlebodies.