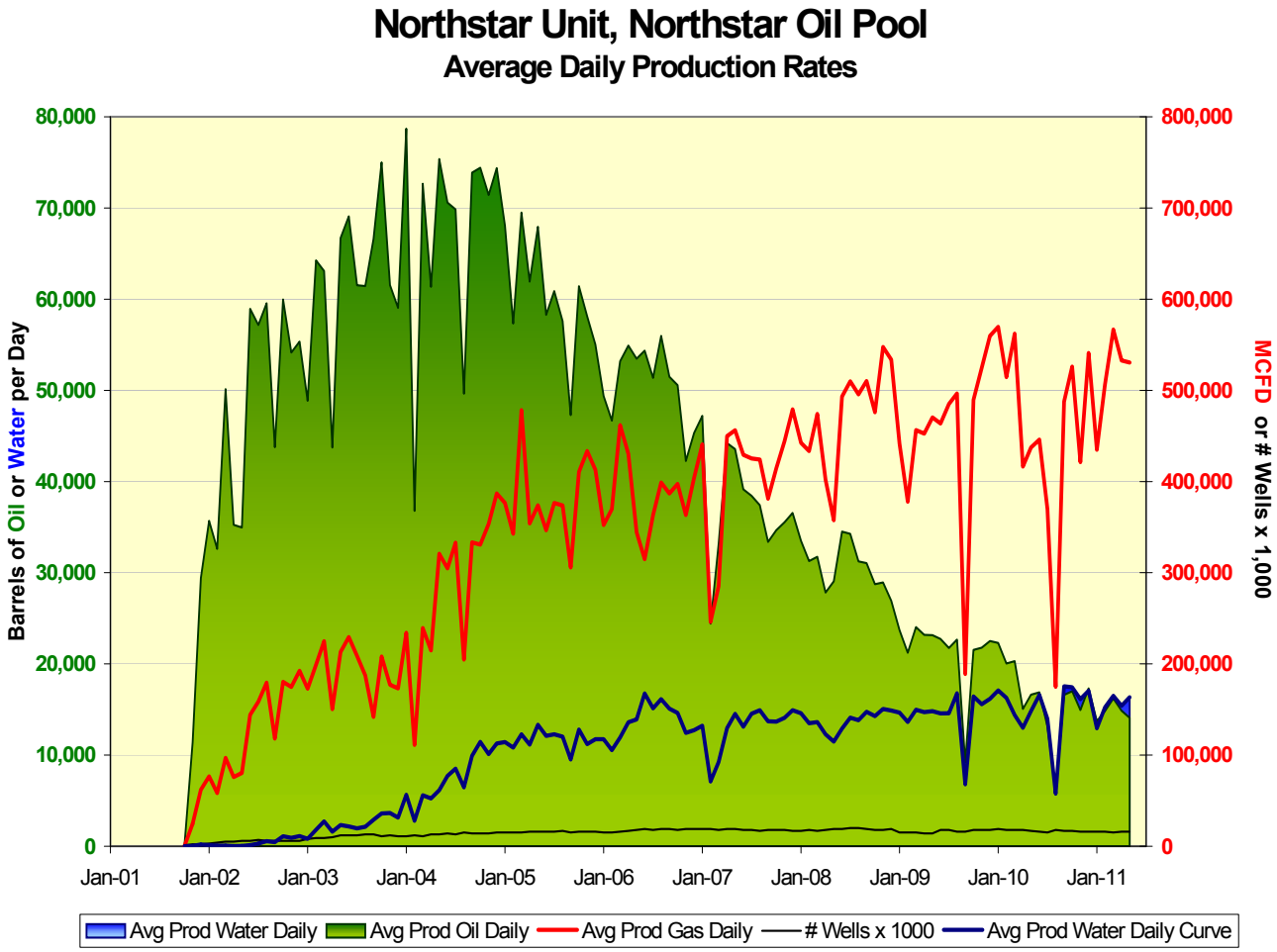
Northstar, Northstar Oil

Summary

Northstar Island is a five-acre,[1] man-made island located in the Beaufort Sea, 12 miles northwest of Prudhoe Bay and 6 miles offshore. Discovered by the Shell Island BF-47 No. 1 exploration well in 1984, construction of the development island began during the winter of 1999-2000, and the first production modules were installed during 2000.[2] Northstar is connected to onshore processing facilities by a pipeline that is buried 7 to 11 feet below the seafloor to avoid ice impacts.[3] This pipeline has a wall thickness triple those of typical onshore North Slope pipelines, and three separate leak detection systems.[4]



Regular production began in November 2001, and climbed rapidly, regularly exceeding 50,000 barrels of oil per day ("BOPD") by June 2002 and 70,000 BOPD by June 2003.[5] During the first five months of 2011, the pool averaged 14,735 BOPD with a 51% water cut.[6] The Northstar development area spans the boundary between State of Alaska and Federal waters, and the Federal percentage of Northstar production is allocated at 17.84%.

Geology

The Northstar Oil Pool is defined as the accumulation of hydrocarbons common to and correlating with the interval between measured depths of 12,418 feet and 13,044 feet the Seal A-01 well. The reservoir interval consists of the Sag River, Shublik, and Ivishak Formations. The Sag River Formation is typically 100 feet thick in this area, and it was deposited as Triassic-aged, transgressive marine sandstone, siltstone and shale. The sandstone mineralogy is mature: quartz with minor amounts of feldspar and authigenic clay. The primary cementing agents are calcite, silica and siderite. Sag River Formation porosity ranges from 6.8% to 22.8% and averages 13%. Permeability ranges from 0.01 to 28.0 millidarcies and averages 0.86 millidarcies. Calculated water saturation values range from 50% to 65%. The net-to-gross ratio for the Sag River Formation varies from 15% to 20%.[7]

The Shublik Formation is also Triassic-aged, and is stratigraphically complex, being characterized by marine siltstone, shale, sandstone and phosphatic limestone. Within the Shublik Formation, reservoir quality rock is limited to a basal sandstone member, the Shublik D. Porosity and permeability for the Shublik D are typically less than 10% and 1 millidarcy, respectively. The net-to-gross ratio for the Shublik D is about 50%. [8]

The Ivishak Formation comprises a series of Permian and Triassic-aged delta-front sandstones and shales that grade upward to fluvial sandstone and medium to coarse-grained pebbly conglomerates. Within the pool, the Ivishak is about 325 feet thick, and it is more proximal, coarser grained, more deeply buried and cemented than at the Prudhoe Bay Field. Here, the Ivishak is primarily cemented with calcite, silica and siderite. The lower sand unit of the Ivishak Formation has an average porosity of about 18%, and the overlying conglomerate unit averages about 14%. However, laboratory studies show that about 40% of the total porosity within the lower sand unit is non-effective micro-porosity, and within the conglomerate unit, about 50% of the total porosity is non-effective micro-porosity. Core permeability ranges from 0.01 to 808 millidarcies, with a stress-corrected mean value of 53 millidarcies. The net-to-gross ratio for the Ivishak is 93% to 95%. The average oil saturation of the Ivishak is 42%, and the maximum oil column is estimated to range from 270 to 300 feet.[9]

The pool structure consists of a faulted anticline defined by three-way dip closure on west, south and east. Closure to the north is obtained through fault seal or structural dip. Faults within the pool have interpreted maximum vertical displacements of less than 200 feet, and they are not expected to significantly affect reservoir performance. The oil-water contact is placed at 11,100 feet true vertical depth subsea, based on core, RFT, MDT and well test data.[10]

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[1] BP, 2003, North Slope Oil Fields, published as alaska_north_slope_oilfields[1].pdf
[2] PI/Dwights, 2004, Beaufort Sea's Northstar Field Resumes Production; in PI/Dwights Drilling Wire, V. 50, No. 9, March 3, 2004
[3] PI/Dwights, 2004, cited above
[4] BP, 2003, cited above
[5] Alaska Oil and Gas Conservation Commission, 2011, Well and Production Information Database
[6] Alaska Oil and Gas Conservation Commission, 2011, cited above
[7] Alaska Oil and Gas Conservation Commission, 2001, Conservation Order No. 458, Northstar Field, Northstar Oil Pool
[8] Alaska Oil and Gas Conservation Commission, 2001, cited above
[9] Alaska Oil and Gas Conservation Commission, 2001, cited above
[10] Alaska Oil and Gas Conservation Commission, 2001, cited above